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Contents for February, 1931

LADIES IN WAITING . . . . . FRONTISPIECE 226
From an Etching by Otto Kubler

SCIENCE ENDANGERED. . . . . BY NICHOLAS MURRAY BUTLER 227
Must It Follow the Classics to the Academic Graveyard?

EVOLUTION OF A BABY RATTLE . . . . BY ROBERT S. WILLIAMS 229
Being an Account of Aluminum's Rise in 100 Years

INVENTION AND ECONOMICS . . . . . BY B. ALDEN THRESHER 232
Some Social Implications of Technical Research

THE FASTEST TRAINS . . . . . BY HAROLD E. LOBDELL 235
American Train Speeds Compared with European

TABLE OF REPRESENTATIVE FAST RAILROAD RUNS BETWEEN METROPOLITAN CENTERS IN THE UNITED STATES AND CANADA 236

A MEMORIAL TO ROGERS . . . . . BY LAUREN B. HITCHCOCK 245
The Founder of the Institute Is Honored at the University of Virginia

THE TABULAR VIEW 218
Notes on Contributors and Contributions

THE TREND OF AFFAIRS 238
The Past Month in Science and Engineering

BOOKS 244
Review and Comment

THE INSTITUTE GAZETTE 246
Relating to the Massachusetts Institute of Technology

THE COVER . . . . . *From a Water Color by* CASS GILBERT
"Marldon Church"

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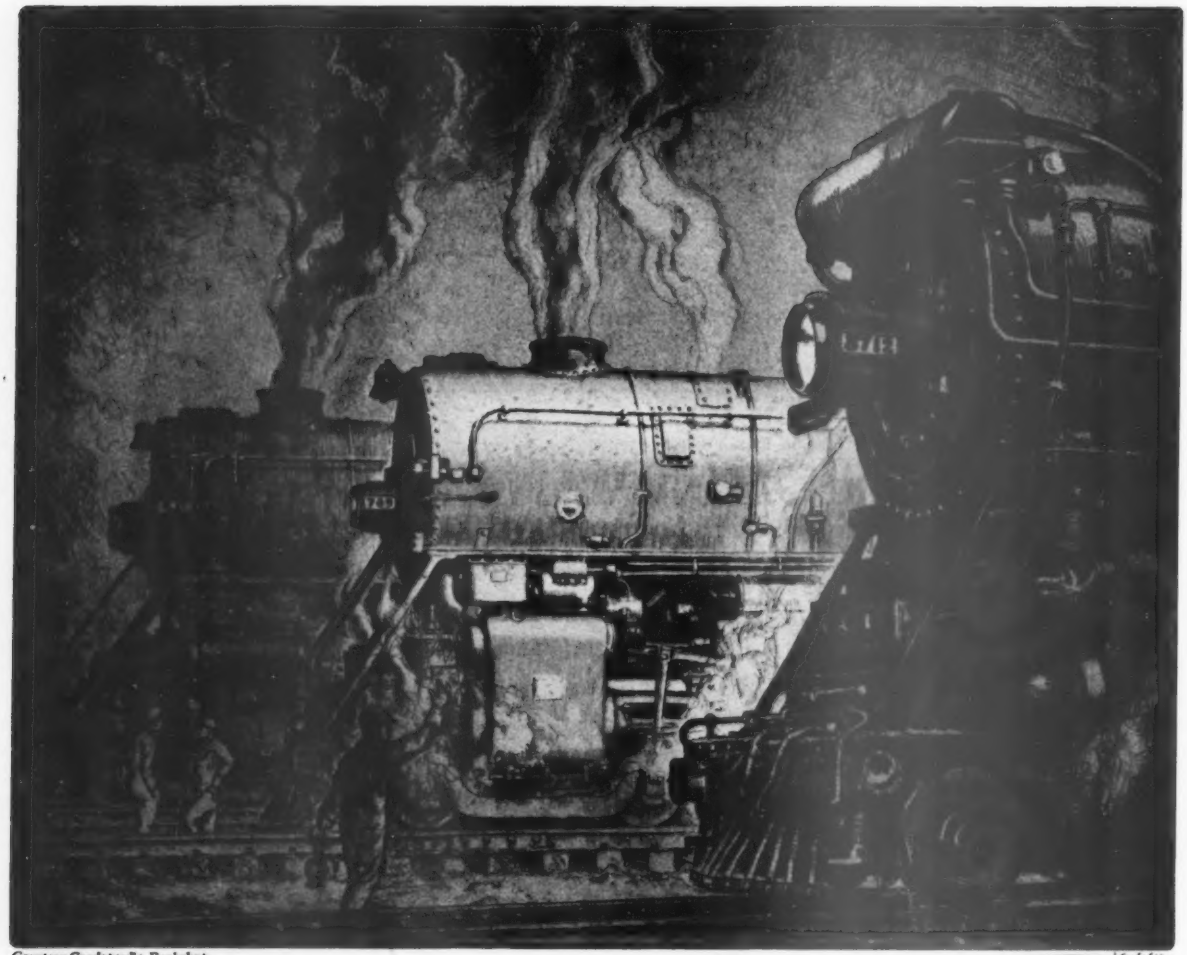

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LADIES IN WAITING

From an Etching by Otto Kubler

SOMEONE has said that dinosaurs disappeared because the world became too clean for them. For the same reason — and others — the steam locomotive may suffer a similar fate, but its passing will be mourned by many. Edward Yeomans, writing in the November, 1930 *Atlantic Monthly*, is one of these and his lamentations should not pass unnoticed:

"*The steam locomotive is, when all is said that can be said for other devices, about the most dramatic expression of hand and mind coöperation. It is a magnificent piece of craftsmanship. It is the noblest of articulated tools. It fills the whole demand of the imagination as a thing to ride on across the country. A horse is a great and mysterious thing and Job did not overdraw the picture of him, his neck clothed with thunder, pawing in the valley, the glory of his nostrils terrible. But this beast . . . on its 4-6-2 chassis, weighing 360,000 pounds, this amazing simulacrum of life, breathing gently with its duplex air pumps, humming slightly at the safety valve, gleaming faintly on its polished sinews, a huge demonic figure condensed from the darkness, a djinni of the Arabian Nights . . . this beast, I say, is the most impressive symbol of the courage and craftsmanship of man since the clipper-ship era.*

"*And it will presently be gone — as the clipper ship went — and the expressionless electric and Diesel locomotives, efficient and cold, will change poetry into prose on the railroads of the country.*"

THE TECHNOLOGY
REVIEW

VOLUME 33 FEBRUARY, 1931 NUMBER 5

SCIENCE ENDANGERED

*Must It Follow the Classics to the Academic Graveyard?**

BY NICHOLAS MURRAY BUTLER

IT IS hard to imagine anything more sad than the decline and fall of classical scholarship and classical teaching in American education, with the resultant paralysis in the development of our national understanding and our national cultivation. The changed conditions of life and of knowledge being what they are, it would have been quite impossible under any circumstances, as well as unwise, for the ancient classics to maintain their one-time dominance of the best type of secondary school and college education. An appropriate readjustment of their place in the educational program would, however, have been something very different from the substantially complete downfall which has overtaken them. The Greek language and literature, Greek history, Greek eloquence, Greek philosophy and Greek institutional life, a knowledge of all of which is a *sine qua non* to an understanding of the intellectual and the spiritual life of today and to preparation for full participation in that life, have passed quite outside the range either of knowledge or of interest of the present generation of American students and their teachers. Latin, which bade fair to travel the same road, has been checked somewhat in its decline, but nevertheless its situation is parlous in the extreme.

The effects of all this are apparent on every hand. They reveal themselves in a lack of historical knowledge and perspective, in a lack of acquaintance with what is the very best and most fruitful of human experience, and in a lack of understanding of the significance of those literally colossal achievements of the mind and spirit which made ancient Greece and Rome immortal, no matter what fate may befall their history, their literature and their institutions as elements of an educational program. With all these have come also increasing carelessness of good manners and a sorry lowering of literary and artistic standards.

Galloway

INSCRIPTION IN MAIN HALL OF THE ACADEMY OF ARTS AND SCIENCES, WASHINGTON

Hearken to the miseries that beset mankind. They were witless erst and I made them to have sense and be endowed with reason. Though they had eyes to see they saw in vain. They had ears but heard not. But, like to shapes in dreams, throughout their length of days without purpose they wrought all things in confusion. . . . They had no sign either of winter or of flowery spring or of fruitful summer, whereon they could depend. But in everything they wrought without judgment, until such time as I taught them to discern the risings of the stars and their settings. Aye, and numbers, too, chiefest of sciences, I invented for them, and the combining of letters, creative mother of the muses' arts, wherewith to hold all things in memory. . . . 'Twas I and no one else that contrived the mariner's flaxen-winged car to roam the sea. . . . If ever man fell ill, there was no defence. But for lack of medicine they wasted away, until I showed them how to mix soothing remedies wherewith they now ward off all their disorders. . . . Hear the sum of the whole matter — every art possessed by man comes from Prometheus.

— Aeschylus: "Prometheus Bound"

*From the Report of the President of Columbia University for 1930.

Acme

STAIRWELL IN THE NEW HEADQUARTERS OF THE UNION OF METAL WORKERS IN BERLIN

This decline and fall, it must be admitted, has been hastened and made certain by the attitude and influence of a host of those who were themselves teachers of the classics and who were engaged in the promotion of classical scholarship. They saw fit to supplant understanding of the ancient world with a myriad of minutiae of highly specialized learning, and to push far into the background the vitally important art of interpretation which is the essential element of real teaching.

Following the remarkable series of discoveries which began something more than a hundred years ago and which absorbed the attention of classical scholars in Germany, in France, more or less in England, and increasingly in the United States, the classical teacher too often left off the useful task of exposition and interpretation and became a highly specialized research worker in some narrowly bounded field of philology, of epigraphy or of archaeology. Into academic recesses such as these naturally no considerable company of students could possibly follow. Classical studies became identified in the public mind with this sort of minute and highly technical knowledge, and they rapidly lost their commanding and inspiring position as the seat and center of the study of humane letters. So it came about that in time classical studies in the schools and colleges of the United States were first asphyxiated, then embalmed, then incinerated, and finally placed in well-decorated funeral urns in the academic columbarium by those who should have been their glad and eager companions, exponents and interpreters. Minute technical studies had been substituted for literary and aesthetic appreciation and interpretation. When that happened the end was in sight. If there is ever again to be a genuine revival of classical learning — and nothing would more help and uplift American education and American life — it can only follow upon the influence of a group of scholars who are inspired by the ideals at which Greek and Roman art and letters aimed, and who are endowed with a capacity to interpret these in terms to be understood in the light of the world of today. Now and again there is a flash of lightning against this darkly clouded sky that comes from the direction of Oxford or Cambridge or Scotland or France or Italy, but it must be confessed that these moments of illumination are few and far between.

STRANGE as it may seem, the academic subjects whose rise contributed powerfully to pushing the ancient classics into the background appear now to be themselves in danger of coming under the influence of forces wholly similar to those which have destroyed the prestige of the ancient classics and any considerable knowledge of them. The natural and experimental sciences are of fascinating interest to every one who aspires to regard himself as an educated man. For some 400 years the subject matter of these sciences has been steadily and rapidly expanding and as scientific method has increased its power of penetration and multiplied its capacities the world about us has yielded one amazing secret after another until today the limits of scientific knowledge are measured only by the distance from the incredibly vast to the inconceivably small. Earlier and apparently well-established divisions of scientific territory are steadily disappearing. No one can longer tell where physics ends and chemistry begins, and now biophysics has come into existence to burrow through the wall which has separated physics from biology. Mathematics, the earliest tool and instrument of abstract thought, then long regarded as little more than a curious method of playing with the symbolic and the unreal, has reasserted itself at the hands of Einstein as the clue to the structure and fundamental laws of the physical universe. The whole round world has become the playground of the mind. Hypothesis quickly leaps into demonstration and demonstration then with lightning-like rapidity becomes the foundation of new and strange superstructures. To be ignorant of all this, or to be careless of it, is to put oneself outside the pale of that kind and wealth of understanding which are essential to liberal education.

Nevertheless, there are not wanting signs that teachers and research workers in the field of natural and experimental science may yet do for their favorite knowledges precisely what the teachers of the ancient classics have done for an understanding of the life and literature of ancient Greece and Rome. Today if the university student wishes to make himself a specialist in any one of the various fields in which science presents itself to him, the largest ability, the widest knowledge and the most splendid laboratory equipment are at his service. He may quickly be drawn and pushed into the secret places of physics, of chemistry, of biology, of geology, of astronomy or even of mathematics; but how fares it with him who, not wishing to become a specialist in any of these fields, seeks for accurate and (*Continued on page 250*)

TO THE RIGHT: A STUDY IN DETAIL OF AN ALUMINUM PANEL FOR THE CRESTING ON THE ROOF OF THE GERMAN EVANGELICAL CHURCH, PITTSBURGH

BELOW: SECTION OF A HAND-WROUGHT ALUMINUM RADIATOR GRILLE IN A PRIVATE RESIDENCE. OTHER SECTIONS ARE SHOWN ON THE FOLLOWING PAGES

EVOLUTION OF A BABY RATTLE

Being an Account of Aluminum's Rise in 100 Years from Obscurity To a Metal of All Work

By Robert S. Williams

IN 1856 the Prince Imperial of France was one year old, and with that touch of nature which makes the whole world kin, including royal babies, he required a rattle. His desire being a common one, it was fitting that its fulfillment take an uncommon form. A gold or a silver rattle would have been costly, but not uncommon, so the royal attendants searched for another material. Happily, there was a new metal that had first been made in 1827, that cost $300.00 a pound, and that was very rare — a fitting material from which to make a royal rattle. This metal was aluminum, and its use for the Prince's rattle constituted the first known commercial use of that metal.

If the Prince had been born today he would, no doubt, have scorned an aluminum rattle, for the metal has, of course, become very commonplace and its price 23¢ a pound. Instead of its being devoted exclusively to the manufacture of rattles, the royal attendants would find it used for manufacturing great structural beams 90 feet long and more than one foot thick. They would find it used for airplane parts, railroad coaches, and probably a majority of their food would be cooked in kitchen utensils made of it. They would find gleaming aluminum spires on buildings, and even buildings supported by aluminum frame work. In short, they would discover that metallurgists had taken a rare substance and developed it into one of the most useful and versatile modern metals.

The first authentic use of aluminum in America is recorded in the manufacture of a surveyor's transit in 1876. This instrument was in constant use until 1909 when it was taken back by the original manufacturers and is now in their museum. In 1884 a small pyramid of aluminum six inches at the base, about ten inches high, and weighing 100 ounces, was cast to form the cap of the Washington Monument. It has been subjected to constant weathering for more than 45 years and still reflects the sun from its exposed surfaces.

In 1889 a young student, Charles M. Hall, announced his invention of the modern electrolytic method of producing aluminum and, as a result, the price dropped rapidly. At that time Hall offered to sell it for $2.00 a pound in 1,000-pound lots but was unable to interest anyone as no one wanted 1,000

pounds of aluminum. In the ten years following the Hall invention, the production of aluminum parts increased somewhat but the uses were not of great industrial interest. However, at the Chicago World's Fair in 1893, an exhibit of aluminum parts attracted much attention. This included metal back brushes, collar buttons, salt and pepper sets, combs, pen holders, and similar articles which were unusual and attractive because of the color of the metal and its light weight.

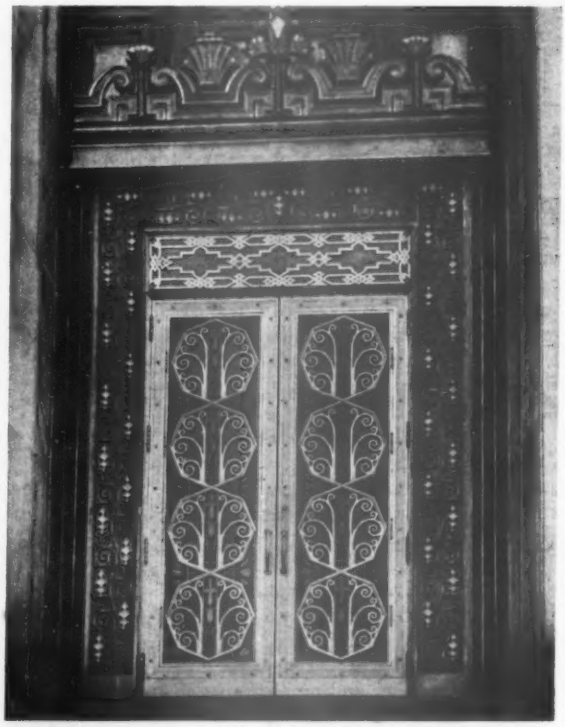
The development of the automobile industry gave a great impetus to the development of aluminum alloys and there was a constant improvement in the properties of these metals in the cast condition. In 1911 an epoch-making publication by Wilm in Germany announced the production of a new alloy which made possible the airship of the zeppelin type, all metal airplane and many other machines that could not have been made without a light, strong metal. This alloy was named duralumin or, as it is coming to be called in modern parlance, dural. As originally made, it contained approximately 96% aluminum, 3.5% copper, and 0.5% of magnesium. While slight changes in composition have been made since that time, the original dural is still very widely used for many purposes.

The most remarkable property of this new alloy was due to the fact that its strength and ductility were both increased to a great extent by its method of manufacture and heat treatment. Up to the time of Wilm's discovery, aluminum alloys had been used for the most part in the cast condition with tensile strengths of 20,000 to 30,000 pounds per square inch although its ductility values were low. In the production of duralumin the metal is first cast in the usual way, then heated to about 300° C., after which it is soft enough so that it can be rolled into sheets or various structural shapes, into the small ribs used in airship construction, and into large structural beams now being produced by the Aluminum Company of America at their Massena, N. Y., plant. After the metal has been formed at this temperature, it is heated to about 500° C. and suddenly cooled by dropping it in water, oil, or some other cooling medium. Immediately following this quenching operation, the duralumin has a tensile strength of about 33,000 pounds per square inch, but within a few minutes after its removal from the quenching tank it is found that the tensile strength has increased and it continues to increase over a period of hours or sometimes days until it finally increases in strength to about 65,000 pounds per square inch with an elongation of roughly 17%. In this new alloy, then, we have a metal as strong as the steel used in making steam boilers and as light as pine.

The development of this alloy has made possible the building of many things that formerly could not have been made. Perhaps the outstanding use is in the manufacture of airplanes and airships although there are many other uses which, while less spectacular, are of equal

APPEARANCE OF CAST ALUMINUM SPANDREL WHEN TAKEN FROM THE SAND BEFORE CHASING AND FINISHING

importance. Street cars, automobile bodies, and automobile parts have been made of it. Its use is being considered now for the building of railway coaches, particularly by the Pullman Company as the great decrease in weight will be of immense value in the operation of the very heavy trains. An all-aluminum railroad tank car, of riveted construction, has been built for the transporta-



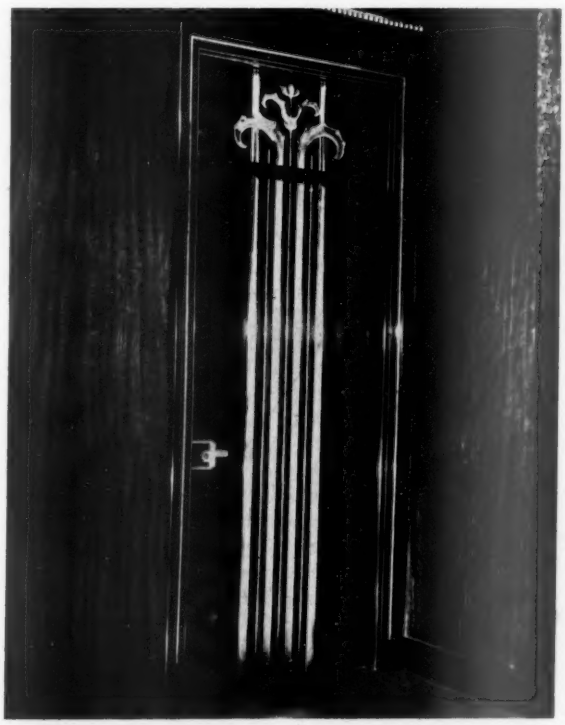
DEPLATED AND HI-LIGHT ALUMINUM CASTINGS MAKE UP THIS EFFECTIVE ENTRANCE TO THE NEW KENSINGTON RESEARCH LABORATORY OF THE ALUMINUM COMPANY OF AMERICA

tion of acetic acid. It is being tried in an experimental way in the manufacture of connecting rods for large locomotives. The decrease in weight will cut down the pounding action of a heavy steel connecting rod to such an extent that locomotive operation will undoubtedly

ILLUSTRATIONS APPEARING IN THIS ARTICLE ARE BY COURTESY OF THE ALUMINUM COMPANY OF AMERICA

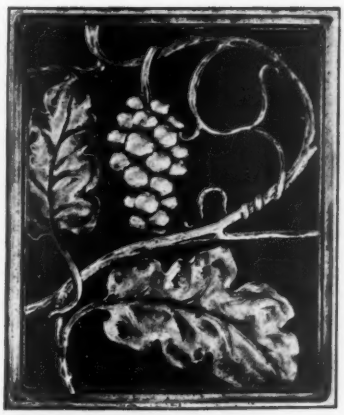
be increased possibly 15 or 20% with no more wear on the rails.

One of the most recent developments in the use of duralumin has come as a result of the development of the new material alclad. This is made by coating duralumin with aluminum of extremely high purity. The pure metal serves to protect the duralumin beneath it from corrosion



ALUMINUM TUBING AND EXTRUDED SHAPES GIVE A DISTINCTIVE AND MODERNISTIC APPEARANCE TO THE NEW YORK SALES OFFICE OF THE ALUMINUM COMPANY OF AMERICA

to a marked degree. The alclad sheets have been made so thin and light that they have been used to replace the fabric in the lighter-than-air ships of the zeppelin type. Alclad was used to cover the Navy's ship ZMC-2 and may be used in place of fabric in the building of the large airships at the Goodyear plant.



The possible uses of alloys of aluminum in the future are innumerable and work is being carried out actively in many laboratories looking toward the development of new and better alloys for various purposes.

The use of aluminum as an architectural material is almost unlimited. Since it can be fabricated in much the same way that other metals are, and in many instances much more easily, and since it is not affected by ordinary atmospheric gases, and is corrosion-resistant, it is rapidly becoming one of the architects' most important and useful materials. When aluminum oxidizes it turns to a pure white powder which serves as a protective covering. There is nothing in it that will stain stone work of other materials.

So far, aluminum has been used mainly for spandrels. Since its weight is approximately one-third of that of other metals it is much easier to handle, and its cost of installation is less. Over 900 aluminum spandrels were used on the Koppers Building in Pittsburgh and it is estimated by the owners of this building that the erecting cost of these aluminum spandrels was 40% less than the cost of cast iron spandrels. Structural shapes of it are being used to a limited extent to replace steel beams and girders in tall buildings, especially in the towers.

It has also been demonstrated that it would be very excellent material for roofing, for terrazzo strips, window sills, elevator doors, and for ornamental metal work.

Because of its heat transmitting quality, it makes a suitable material for radiators. Its imperviousness to moisture makes it an excellent material to use for mop strips in bathrooms, and in experimental form for water pipes. Enamel aluminum has been used exteriorly on the new research laboratory building of the Aluminum Company of America. It has been found that it can be dyed also, making it possible to finish the metal in various colors suitable for either exterior or interior use. Dyed aluminum is now on the market.

The multiplicity of uses to which aluminum and its alloys are being adopted attests to the ingenuity of the metallurgist, and to his growing mastery of metals. In past issues The Review has spoken of other great developments that have poured out of the metallurgical laboratories in rich profusion: carboloy, the austenic steels, methods for making rare metals available cheaply. The story of aluminum is an earnest of what the future holds.

Rittase

THE CHALLENGERS

INVENTION AND ECONOMICS

Some Social Implications of Technical Research

By B. Alden Thresher

THE dividing line between invention and "improved practice" is a notoriously elusive one. For convenience, the term innovation may be used to cover both, and so to include all those changes in the practical arts and technique of physical production which abridge and lighten labor, and give rise to new products. The dominating importance of such innovation in the present age is a matter of common notoriety, and it is not necessary here to indulge in platitudes concerning it. Moreover, because the entire economic and social system under which we live is so profoundly affected by this phenomenon, it is a matter of some interest to trace a few of the ways in which economists and social philosophers have regarded it, and endeavored to fit it into their generalizations regarding the economic system and, indeed, the whole structure of society.

Writing in 1691, Sir William Petty, that pioneer statistician and economist of the seventeenth century who combined the practical wisdom of the man of affairs with no small degree of philosophic insight, put his finger upon the very nub of the twentieth century problem of research as a factor in the economic world. What are its collateral effects on society likely to be? How can its economic worth be evaluated? How are the resulting benefits likely to be distributed among the innovators themselves, their employers, the various classes of the consuming public, and posterity? The answers to questions such as these depend upon an economic analysis of the functions and significance of innovation.

"We must make," said Petty, "a Par and Equation between Art and Simple Labour; for if, by such Simple Labour, I could dig and prepare for Seed a hundred acres in a thousand days, suppose then I spend a hundred days in studying a more compendious way, and in contriving tools for the same purpose; but in all that hundred days dig nothing, but in the remaining 900 days I dig 200 acres of ground; *then I say that the said Art which cost but 100 days' Invention is worth one man's labour forever; because the new Art and one Man performed as much as two men could have done without it.*"

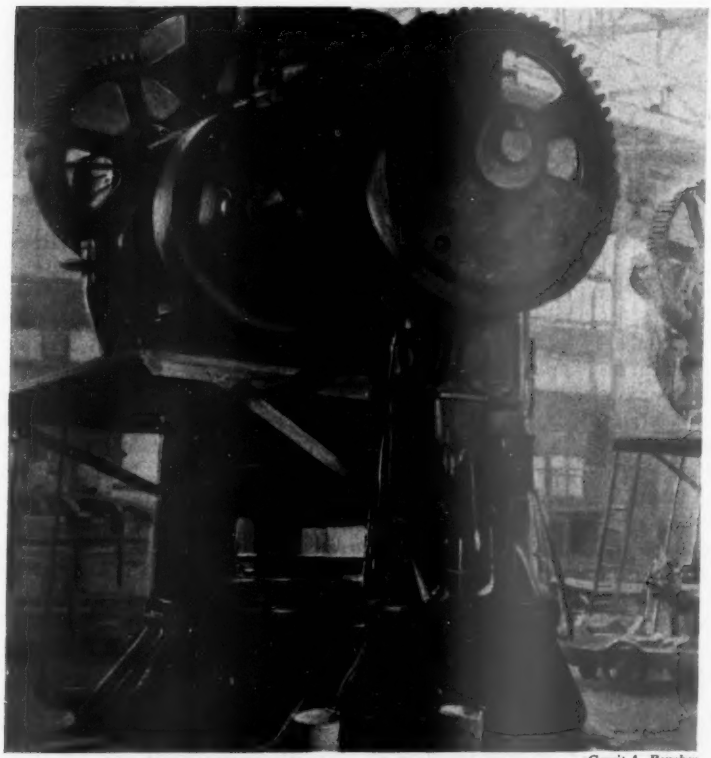
That intangible element which Petty calls Art is the pearl of great price which big business is now seeking. Simple labour is a drug on the market. When something is available which is worth one man's labor forever, it is not surprising that it should be assiduously sought after. Here are two instances, taken at random, which

show that the search has not gone unrewarded: a recent press release states that as a result of the work of the Bell Telephone Laboratories "on eight selected items there resulted an estimated saving in first cost for the Bell System of $1,000,000,000 from the year of development to the end of 1929." Or, again, according to the National Electric Light Association, electric light now costs less than 5% of what it did in 1880, due to (1) reduction in rates for current, (2) improvements in the efficiency of lamps, (3) reduction in the prices of lamps. There is bitter controversy regarding the extent to which these improvements have been and should be passed on to the consumer, and how far the large industrial user of power may justifiably be favored at the expense of the small domestic consumer. In the heat of the legal controversy over rates and valuation, with its necessary emphasis on plant investment, and other tangible capital goods, it is easy to lose sight of the intangible elements of knowledge and technique which underlie the whole question, and which are more fundamental in their long-run effects upon society.

But I am concerned here neither with the public utility question as such, nor with illustrative instances of the practical results of technical innovation. Instances such as have just been cited are commonplace and well known to every informed reader. My concern, for the moment, is with the underlying theoretical analysis of innovation and the ways in which changes in technique are, so to speak, geared into the going economic system. In the main it appears that the progress of innovation serves as a prime mover which in turn sets up profound economic and social change through various kinds of economic nexus. There is also a reverse action by which the needs of society in turn react upon the course of research and invention, influencing their scope and direction. It is this latter phenomenon which has given rise to the somewhat questionable proverb that "necessity is the mother of invention," to which the pertinent proviso has been added that necessity is sometimes unconscionably delayed in bringing forth her children.

The average educated man who has given no special thought to the economics of invention is likely to harbor what the psychologists call stereotype ideas regarding it. The first of these is the Industrial-Revolution stereotype. This set of ideas is commonly the result of a college course in the elements of economics, in the incipient stages of which something was said about the Industrial Revolution. This event is regarded as one of those old, unhappy, far-off things from which attention would, happily, be soon diverted to consider more timely matters. A prominent place in this stereotype is occupied by the great inventions in textiles, steam power, metallurgy and machine tools by Watt, Arkwright, Whitney, Stephenson and the rest. This sudden outburst or saltation of the inventive faculty is conceived to have given rise to the factory system with its attendant increase of physical output, and with all the crying evils which, under the *laissez-faire* scheme of things, it brought in its train.

Then there is the Sunday-Supplement or romance-of-engineering stereotype. Fed by the lurid word-painting of some writers on popular science, the unwary reader is led to believe that the confraternity of scientists and engineers can work miracles continuously and indefinitely upon demand; that the world is likely to be revolutionized over night in consequence; and that this body of wonder workers are not as other men, but dwell in a world apart, among mysteries not accessible to the vulgar. In this picturesque viewpoint the spectacular and the striking are ever to the fore, making it difficult to form any balanced idea of the real nature of the rôle of science in technical innovation.



Gerrit A. Beneker

"GRAY MATTER" ("THE IRON MAN"), PAINTED IN THE MILLS OF THE HYDRAULIC STEEL CO., CLEVELAND, OHIO

There is obviously some truth in both these stereotypes of the popular mind. The Industrial Revolution unquestionably started something. In the first place, it is not to be regarded as a dead-and-gone event, of no more significance in current affairs than, say, the history of bi-metallism. On the one hand, as recent researches of the economic historians have shown, its roots lie centuries back, in a long series of gradual technical discoveries and improvements which, for reasons even now not wholly clear, blossomed out and came suddenly to fruit in the particular conjuncture of circumstances which existed in England 150 years ago. The heroic theory of invention has long been discredited. The instinct of contrivance is known to be widely distributed among all kinds of men and the process of innovation

to be an almost continuous one, carried on now by taking the next and most obvious step and again by intervals of synthesis in which isolated improvements and technical elements are combined to form a significant new development. On the other hand, the Industrial Revolution is seen to be not merely a past event, but only an early manifestation of a series of forces which are even now still growing in intensity. It is a movement in the midst of which we find ourselves, and we are still at many points baffled in our attempt to deal collectively with it.

So it is with the other stereotype. There is unquestionably much in the latterday progress of applied science to touch the imagination, but to allow this emotional stimulus to work itself out solely along romantic lines is to miss its real significance. The work of scientific and industrial innovators is too commanding in its effects to be merely set up as a nine-days' wonder, to be gaped at in uncritical astonishment. Its repercussions upon the structure of society are too vital for human welfare to justify this easy course. It becomes, therefore, a major task of the social scientist to find out what is really happening and what the results are likely to be. The abstract laboratory problem of today becomes a social and economic problem tomorrow, with much attendant tumult and shouting. The economist has a peculiar interest in the problem, because it is through the working out of economic influences, in the first instance, that technical innovation carries out its effect on society. The economist has far to go before he can deal with his aspect of the problem with anything like the assurance that the physical scientist exhibits.

Riltase

DISPATCH

Current affairs are affected at every turn by the influence of innovation. In technological unemployment its weight falls on the working man. In the various phases of plant obsolescence, capital feels its blows, which are often sudden and not easily foreseen. A collateral subject which has been arousing the interest of technical men is the question of what share the innovator shall have in the profits accruing, as against the corporation which employs him. There is the vexed question of discrimination among different classes of consumers, as in the electric power industry. There are the more obvious changes in consumption and habits of living which innovations bring about; and as a manifestation of the growing pressure of innovation in the business world, there is the growth of institutions such as Technology, so closely articulated with the innovative work of industry.

Now the striking feature of the art which Sir William Petty supposed to result in a "more compendious way" of doing a given job is the marked disproportion, or perhaps we may say the lack of any definite relation whatever between the human effort that goes into the contriving and the importance and value of the results. A clever dodge, hit upon in a moment of reflection, may have vast consequences in lightening labor or in adding to its physical product; or, again, years of effort may be expended, only to come to naught. It is a chanceful business at best, even under present-day conditions of organized research, where every effort is made consciously to guide the path of development.

Here arises the first obstacle in trying to deal with the fact of innovation under traditional economic categories. The work of the innovator is obviously labor, since it is the product of human effort. Yet it is equally obvious that by no stretch of the imagination can such work be evaluated on any basis of labor-hours, or quantity of labor, as Ricardo and later the socialists would have expressed it. Sometimes the desired results come about as planned; sometimes they do not. Often wholly unexpected consequences occur, either directly as the result of research or collaterally, in industries apparently remote from the field under investigation. Nineteenth century economists, seeing that labor was of (*Continued on page 250*)

THE FASTEST TRAINS

American Train Speeds Compared with European

By Harold E. Lobdell

NEWS of the shattering of a speed record, whether by airplane, over the rails, in a racing auto or motor boat, by rocket car or parachute, or other means seldom fails to excite curiosity, admiration, awe, or debate. Sometimes it excites all if the new triumph seems to presage a mode which an ordinary mortal may expect to find himself using ten or a dozen years hence.

But of greater immediate concern to most of us is the commonplace increase of ordinary, everyday speeds at which existing common carriers are moving passengers. That, on a certain one day in June, 1927, a special train carried Lindbergh films from Washington to New York at 72 miles per hour, is not of such moment as the fact that anybody can be transported either way between these two cities any day in the year on the *Congressional Limited* at a 50 mile-per-hour average including stops. Again, by a combination of two special trains in March, 1924, the wife of a railroad president made a record by traveling from Los Angeles to New York in 69 hours and 7 minutes. This record still stands but today by regular daily services (Santa Fe's *Chief* and New York Central's *Fast Mail*) it only takes 8 hours 3 minutes longer despite 21 intermediate passenger stops and over an hour's delay for connections at Chicago.

Crack railroad trains were preëminently the swiftest regular means of travel over land until the advent of scheduled airplane services. For years, a "mile-a-minute" connoted the acme of speed for ordinary travelers. Now, of course, in a plane one or more times a "mile-a-minute" is customary.

But congenital prejudices, a desire for comfort in travel, an apprehension of unauspicious weather conditions and attendant uncertainty as to the maintenance of schedules, contribute to the problems of airline operators. For these and other reasons, despite the prevalence of air travel in Europe, despite its remarkable growth here in the past few years aided by mail contracts, cut rates and fostering by some of the railroad companies, rapid transit between large cities still implies a train to the average American.

That airplanes land on the outskirts of a metropolis while railroad terminals are almost always located well in town, is a point that weighs heavily. This is but another way of stating that sustained speed between cities, figured without deduction of time for intermediate stoppages, is what counts. Hence the *shortening* of everyday times by rail in the United States and Canada in the last decade is noteworthy, particularly since they *increased* during the preceding decade except for longer runs of over 2,000 miles. The times for these latter have picked up steadily since 1910.

To illustrate the trend in some detail The Review has compiled the table shown on the succeeding two pages. It gives the times, distances and average maintained speeds of trains on 30 representative fast American and Canadian runs, aggregating a total mileage of over 30,000. It will be observed that the runs included range from the 226-mile New York-Washington service to the 2,886-mile trek from Montreal to Vancouver. They divide into groups according to their mileage: a third vary between 200 and 475, about a third between 475 and 1,000, 5 are between 1,000 and 1,200, and 7 are over 2,000.

A summation of the hours and mileages of the speediest trains on each of the 30 individual runs in 1930 indicates a combined average of 40.9 miles per hour. For 1920 the corresponding figure was 34.0, for 1910 it was 34.6. Similar computations for the subdivisions mentioned above show strikingly the decline in average maintained speeds between 1910 and 1920 (except for the longest distances) and the subsequent rise between 1920 and 1930:

Group	*No. of runs*	*1930*	*1920*	*1910*
200–475 miles	10	47.2	40.5	42.3
475–1,000	9	41.8	35.5	36.5
1,000–1,200	5	45.2	39.8	43.6
Over 2,000	6	37.8	30.5	29.9

A study of the table on pages 236 and 237 will suggest the question of how the increases have been effected. The answer does not lie entirely in the reduction of the number of intermediate passenger stops for they remain materially unchanged for 1930 as compared with 1920 on well over half of the runs. Better roadbeds and motive power, heavier rails, curve and grade elimination, and fewer operating stops to take on water and fuel are contributing factors. In some cases a special feature such as Hell Gate Bridge which, with tunnels under Manhattan, displaced a train ferry, has had a marked influence. On the western roads a tunnel under a mountain range has often worked wonders. The Cascade of the Great Northern, for example, besides shortening the line 9 miles, lowered the summit over 500 feet, eliminated curvature equivalent to 10 complete circles and did away with 18 miles of maximum grade.

Inevitably a discussion of train speeds on this side of the Atlantic prompts a comparison with European services. A Great Western train covers the 77.3 miles between London and Swindon in 70 minutes. It is acknowledged to be the fastest British train for a comparatively short run and another which approaches its speed is one on the London and North Eastern between Darlington and York. Its run is 44.1 miles and the time 43 minutes. Neither of these trains makes an intermediate stop. With these two trains the times of the expresses between Camden and Atlantic City compare not unfavorably. The Reading connects these points with a line 55.5 miles long and the Pennsylvania with one of 59.7. The times of their fastest trains are 55 and 58 minutes, respectively.

On a number of longer European runs excellent swift service is maintained without intermediate stoppage between terminals. Some of the (*Continued on page 260*)

Table of Representative Fast Railroad Runs Between Metropolitan Centers in the United States and Canada

(Figures after names of trains indicate hours, mileage, and average speed, respectively. Example: Pennsylvania's *Congressional Limited's* present schedule from New York to Washington in 4.5 hours over a distance of 226 miles is at an average of 50.2 miles per hour.)

Number of Run	Terminals of Run	Railroad	1930		1920		1910		Number of Run
1	New York-Washington	Pennsylvania	*Congressional Ltd.*	4.5 – 226–50.2	*Congressional Ltd.*	5.1 – 226–44.4	*Congressional Ltd.*	5.0 – 226–45.2	1
2	Boston-New York	N. Y. N. H. & H.	*Yankee Clipper*	4.75– 229–48.2	*Merchants Ltd.*	5.2 – 229–44.1	*Merchants Ltd.*	5.0 – 233–46.6	2
3	Chicago-St. Louis	Illinois Central	*Michigan Boulevard* [1]	6.5 – 294–45.3	*Daylight Special*	8.0 – 294–36.8	*Daylight Special*	8.0 – 293–36.7	3
		Chi. & E. Illinois	*La Salle*	6.5 – 290–44.6	*Chi.-St. Louis Ltd.*	7.8 – 290–37.2	*St. Louis Ltd.*	8.0 – 290–36.3	
		Wabash	*Banner Blue Ltd.*	6.5 – 286–44.0	*Banner Ltd.*	7.8 – 286–36.7	*Banner Ltd.*	8.0 – 286–35.8	
		Chi. & Alton	*Alton Ltd.*	6.5 – 284–43.7	*Alton Ltd.*	7.75– 284–36.7	*Alton Ltd.*	8.0 – 284–35.5	
4	Toronto-Montreal	Canadian National [2]	*Inter-City Ltd.*[3]	6.0 – 334–55.6	*International Ltd.*	7.7 – 334–43.4	*International Ltd.*	7.5 – 334–44.5	4
5	Chicago-St. Paul	C. B. & Q.	*North Coast Ltd.*	9.8 – 431–44.0	*North Coast Ltd.*	12.9 – 431–33.4	*Oriental Ltd.*	12.3 – 431–35.0	5
		Chi. & N. W.	*Victory*	9.8 – 396–40.4	*North American*	12.8 – 411–32.1	*St. Paul and Minneapolis Exp.*	10.8 – 412–38.2	
		C. M. St. P. & P.[4]	*Olympian*	9.8 – 410–41.8	*Olympian*	12.4 – 410–33.1	*St. Paul-Minneapolis Spec.*	11.7 – 410–35.0	
6	New York-Buffalo	New York Central	*Empire State Exp.*	8.5 – 436–51.3	*Empire State Exp.*	9.0 – 439–48.8	*Empire State Exp.*	8.75– 443–50.6	6
7	New York-Pittsburg	Pennsylvania	*Spirit of St. Louis*	9.4 – 440–46.8	*Broadway Ltd.*	9.6 – 441–45.9	*Pennsylvania Spec.*	8.75– 439–50.2	7
8	Boston-Washington	N. Y. N. H. & H., Pennsylvania	*Senator*	9.5 – 458–48.2	*Colonial Exp.*	11.75– 458–38.1	*Colonial Exp.*	12.7 – 444–35.7	8
9	Chicago-Pittsburgh	Pennsylvania	*Liberty Ltd.*	9.7 – 468–48.3	*Broadway Ltd.*	10.3 – 468–45.5	*Pennsylvania Spec.*	9.1 – 468–51.4	9
10	San Francisco-Los Angeles	Southern Pacific	*Daylight*	11.75– 471–40.1	*Lark*	14.25– 475–33.3	*Shore Line Ltd.*	13.5 – 475–35.2	10
11	Cincinnati-Atlanta	Southern	*Royal Palm*	12.8 – 491–38.3	*Royal Palm*	17.25– 493–28.6	*Florida Spec.*	15.0 – 494–32.9	11
		Louisville & Nashville	*Southland*	12.8 – 488–38.1	*Southland*	15.0 – 488–32.5	Number 33	14.0 – 487–34.8	
12	Washington-Atlanta	Southern	*Crescent Ltd.*	16.25– 638–39.3	*N. Y. & New Orleans Ltd.*	20.5 – 649–31.6	*N. Y. & New Orleans Ltd.*	19.25– 649–33.7	12
13	Portland-San Francisco	Southern Pacific	*Cascade*	21.2 – 721–34.0	*Oregonian*	32.8 – 745–22.7	*Shasta Ltd.*	27.5 – 745–27.1	13
14	St. Louis-Dallas	Mo.-Kan.-Texas	*Texas Spec.*	17.9 – 767–42.8	*Texas Spec.*	19.25– 767–39.8	*Katy Ltd.*	23.2 – 767–33.1	14
		Missouri Pacific	*Sunshine Spec.*	17.9 – 711–39.7	*Sunshine Spec.*	19.1 – 707–36.3	Number 3	23.0 – 708–30.8	
		St. Louis-San Francisco	*Texas Spec.*	17.8 – 688–38.6	*Texas Spec.*	19.25– 688–35.7	Number 6	22.6 – 684–30.3	
15	Washington-Chicago	Pennsylvania	*Liberty Ltd.*	18.75– 836–44.6	*Broadway Ltd.*	19.75– 837–42.3	*Pennsylvania Spec.*	18.25– 837–45.8	15
		B. &. O.	*Capitol Ltd.*	18.75– 786–41.9	*N. Y.-Chicago Ltd.*	20.7 – 779–37.7	*Chicago Ltd.*	21.3 – 820–38.5	
16	Montreal-Chicago	Canadian National [2]	*International Ltd.*	18.25– 848–46.5	*International Ltd.*	23.3 – 841–36.1	*International Ltd.*	23.7 – 842–35.5	16

17	Cincinnati-New Orleans	Louisville & Nashville	*Pan-American*	23.75- 921-38.8	*New Orleans Ltd.*	28.2- 923-32.7	Number 1	26.5 - 923-34.8	17
		Southern [5]	*Queen and Crescent Ltd.*	23.4 - 836-35.7	*New Orleans Ltd.*	27.8 - 837-30.2			
18	Chicago-New Orleans	Illinois Central	*Panama Ltd.*	21.0 - 921-43.8	*Panama Ltd.*	22.75- 921-40.5	*New Orleans Spec.*	25.25- 921-36.5	18
19	New York-Chicago	New York Central	*20th Century Ltd.*	20.0 - 961-48.0	*20th Century Ltd.*	20.0 - 979-48.9	*20th Century Ltd.*	18.0 - 983-54.6	19
		Pennsylvania	*Broadway Ltd.*	20.0 - 908-45.4	*Broadway Ltd.*	20.0 - 909-45.4	*Pennsylvania Spec.*	18.0 - 909-50.2	
20	Boston-Chicago	B. & A., N. Y. C.	*20th Century Ltd.*	22.25-1019-45.8	*20th Century Ltd.*	22.25-1038-46.5	*20th Century Ltd.*	20.5 -1043-50.9	20
21	New York-Jacksonville	Atlantic Coast Line	*Havana Spec.*	22.5 -1021-45.4	*Florida Spec.*	27.0 -1021-37.8	*N. Y. and Florida Spec.*	24.8 -1018-40.1	21
22	Chicago-Jacksonville	Illinois Central	*Floridian*	29.1 -1127-38.7	*Seminole Ltd.*	34.9 -1132-32.4	*Seminole Ltd.*	33.1 -1133-34.2	22
23	New York-St. Louis	New York Central	*Southwestern Ltd.*	23.0 -1156-50.2	*Southwestern Ltd.*	26.6 -1158-43.5	*Southwestern Ltd.*	24.0 -1175-49.0	23
		Pennsylvania	*Spirit of St. Louis*	23.0 -1052-45.7	*St. Louisan*	24.8 -1053-42.5	*24-hr. St. Louis*	24.0 -1060-44.2	
24	Boston-St. Louis	B. & A., N. Y. C.	*Southwestern Ltd.*	25.8 -1215-47.1	*Southwestern Ltd.*	29.1 -1216-41.8	*N. Y. Central Ltd.*	26.1 -1235-47.3	24
25	New Orleans-Los Angeles	Southern Pacific	*Sunset Ltd.*	56.3 -2008-35.6	*Sunset Ltd.*	62.5 -2003-32.5	Number 9	75.6 -2003-26.9	25
26	Chicago-Los Angeles	Santa Fe	*Chief*	56.0 -2228-39.8	*California Ltd.*	71.5 -2231-31.2	*California Ltd.*	72.0 -2267-31.5	26
		Union Pacific	*Los Angeles Ltd.*	61.0 -2299-37.7	*Overland Ltd.*	72.2 -2301-31.9	*Los Angeles Ltd.*	72.0 -2310-32.1	
		C. R. I. P., So. P.	*Golden State Ltd.*	61.0 -2281-37.4	*Golden State Ltd.*	73.5 -2276-31.0	*California Spec.*	72.0 -2275-31.6	
27	Chicago-San Francisco	C. & N. W., U. P., So. Pacific	*Overland Ltd.*	56.0 -2261-40.9	*Overland Ltd.*	72.0 -2264-31.4	*China & Japan Fast Mail*	66.5- 2278-34.3	27
28	Portland-Chicago	Northern Pacific	*North Coast Ltd.*	57.5 -2316-40.3	*North Coast Ltd.*	72.0 -2312-32.1	*Northern Pacific Exp.*	72.0 -2319-32.4	28
		Great Northern	*Empire Builder*	57.25-2245-39.2	*Oriental Ltd.*	72.0 -2243-31.2	*Oriental Ltd.*	72.0 -2294-31.9	
		Union Pacific	*Portland Rose*	57.5 -2272-39.5	*Oregon-Wash. Ltd.*	72.0 -2266-31.5	*Oregon-Wash. Ltd.*	72.0 -2291-31.9	
29	Seattle-Chicago [7]	Northern Pacific	*North Coast Ltd.*	58.5 -2335-39.9	*North Coast Ltd.*	73.2 -2335-31.9	*Northern Pacific Exp.*	74.25-2342-31.5	29
		Great Northern	*Empire Builder*	57.25-2196-38.4	*Oriental Ltd.*	72.0 -2206-30.6	*Oriental Ltd.*	72.0 -2256-31.3	
		C. M. St. P. & P. [4] [6]	*Olympian*	58.0 -2188-37.7	*Olympian*	72.0 -2190-30.4			
30	Montreal-Vancouver	Canadian Pacific	*Trans-Canada Ltd.* [8]	86.25-2886-33.5	*Imperial*	111.25-2886-25.9	*Pacific Exp.*	112.5 -2897-25.8	30
			Imperial	98.75-2886-29.2					
	Total times and mileages of fastest trains on each run			**743.5 hours—30,463 miles**		**898.15 hours—30,607 miles**		**886.1 hours—30,674 miles**	
	Average speed maintained by 30 fastest trains			**40.9 mi/hr.**		**34.0 mi/hr.**		**34.6 mi/hr.**	

[1] When two or more trains of same railroad maintain schedule listed in the Table, the name of but one appears. Examples: Illinois Central now has two 6.5 hr. trains between Chicago and St. Louis, *Michigan Boulevard* and *Daylight;* Chicago & Eastern Illinois on same run also has two, *La Salle* and *Zipper.*

[2] In 1920 and 1910 this part of present Canadian National was part of Grand Trunk Railway System.

[3] *Inter-City Ltd.* maintains 6 hr. schedule eastbound only; *International Ltd.* maintains it westbound.

[4] The present Chicago, Milwaukee, St. Paul and Pacific was the Chicago, Milwaukee and St. Paul in 1920 and 1910.

[5] In 1910 the Southern maintained no through Cincinnati-New Orleans service.

[6] In 1910 the Chicago, Milwaukee and St. Paul maintained no through Seattle-Chicago service.

[7] If schedules in opposite directions differ, the fastest is listed in the Table. Examples: *North Coast Ltd.* now has a schedule of 58.5 hrs. eastbound Seattle to Chicago and 60.25 hrs. westbound; *Empire Builder's* eastbound schedule between same points is 57.25 hrs. and 59.15 hrs. westbound; *Olympian's* eastbound schedule is 58 hrs. and 59.75 hrs. westbound. Such differences are usually to permit arrivals at intermediate terminals of importance and convenient connections with other trains.

[8] *Trans-Canada Ltd.* — summer train only.

THE TREND OF AFFAIRS

Prodigality in the Natural Gas Industry

THAT the conservation and use of natural gas affords a means of conserving our oil supply is a fact not generally known to the layman. Neither does he realize that, despite the growing use of natural gas, conservation has made little headway and that millions of cubic feet of gas are being wasted every day in bringing oil to the surface — one of the most appalling in the long list of stupidities prevalent in the exploitation of our natural resources.

In 1929 the *consumption* of natural gas in the United States was 1,918 billion cubic feet, or about five billion cubic feet per day. It is estimated that the total *production* amounted to seven billion cubic feet per day. What happened to the difference? It was blown into the air, completely wasted. Since the average price of gas at the wells in the United States was 8.2 ¢ per M (1,000 cubic feet), the value of this wasted gas at the well amounted to approximately 60 million dollars for the year. At the point of consumption it would have been worth 160 million dollars. That was in 1929. Conditions were probably worse in 1930.

It must be understood that most of our wasted natural gas comes out of oil wells (oil is produced in 18 states and natural gas in 23); that it is a by-product of oil production. Since there is an over-production of oil, it becomes immediately evident that the control of gas wastage would also mean a reduction of oil production. It is estimated that the two billion cubic feet of gas blown wild in 1929 represented the production of 400,000 barrels of oil, none of which the world actually needed. The oil wells in the United States, from which gas is conserved and used, supply enough oil for present demands and oil brought up with the wasted gas simply represents a glut on the market.

Several producing states have passed laws making it illegal to allow gas to blow wild and the United States Supreme Court has upheld this method of oil conservation. Despite these examples, the following table shows the estimated wastage in million cubic feet per day in several states during 1929:

California	600
Oklahoma	400
Texas Panhandle	500
West Texas and New Mexico	250

Not only does gas blown in the air represent a waste of gas, but it likewise represents an actual waste in oil since it carries with it a certain amount of oil. The wasted gas probably contains about one gallon of gasoline per 1,000 cubic feet. *It is also true that it is the gas which expels the oil from the sand and that the more efficiently the gas is used, the greater the extraction of oil from the sand.* Natural gas is the most convenient known fuel for domestic purposes. It contains practically twice as much heat per unit as artificial gas and it has a minimum of dirt, smoke, and odor. In short, it is one of our most precious resources and one that we can ill afford to blow skyward at the rate of two billion cubic feet a day. Is it not possible that some adequate method of public control can be devised which will prevent this wild wastage and at the same time keep oil in the ground that we do not need?

M. I. T. Photo

STILL LIFE IN THE STEAM LABORATORY

What Price Beryllium?

ALUMINUM was once a metal so rare and costly that only a prince could have an object made of it. Does its history, as related by Dr. Williams on page 229, reveal the future of a similar metal, beryllium, almost as expensive and as difficult to separate from its compounds as aluminum once was?

Beryllium is widely distributed in nature, and its principal mineral is found in many places. It has been mined chiefly as a mineralogical specimen,

for this mineral, beryl, sometimes occurs in very beautiful and gigantic hexagonal crystals; one form, indeed, is one of the rarest and most valuable gems, emerald. Beryl is found in association with mica and feldspar, and in some localities where these two minerals are mined, the beryl has been rejected as mere gangue; it is said that there are quite large accumulations of the mineral on the dumps.

Within the past year, however, several things have occurred which seem to point to almost immediate development of a cheap process for the recovery of this metal, and consequently a quick extension of its use. A manufacturer in New York City has announced that he has a new process which will make it possible to produce beryllium so that it can be sold for three or four dollars per pound, and that within a year after the establishment of his factory, which will be erected immediately, it can be sold for perhaps two dollars. At about the same time there comes a promising preliminary announcement from two chemists in the laboratories of Western University of a process for electrolysing beryllium compounds.

At the same time, several investigators are busy trying to learn all there is to know about the properties of this metal and its alloys, preliminary to developing a practical use for these new substances. In the United States, greater attention is being directed to alloys with aluminum, magnesium, and silicon, which are all of small specific gravity. In Germany, the alloys with the heavier metals are receiving the greatest attention.

Beryllium is lighter than aluminum, which it resembles in appearance. Unfortunately, unlike aluminum, it is brittle, and therefore not easily worked. It is true that one investigator in England claims to have produced an extremely pure beryllium that is malleable and ductile; but this is contrary to the experience of others. Unless a workable pure metal is ultimately found, the chief use, of course, will be in the form of alloys.

Recent experiments made through a series of years in the laboratories of the Siemens-Konzern in Germany seem to indicate that alloys with the heavier metals will have very useful properties, even when the proportion of beryllium in the alloy is small. For example, alloys of beryllium and copper show properties which indicate their adaptability to uses where bronzes and brasses have had their greatest application, such as in bearings and springs. Beryllium copper alloys are of greater strength than phospher bronzes. One test in hard usage was on electric locomotives for the contact-brushes on the motors and for the collectors sliding on the third rails. These alloys are also resistant to corrosion by most agents, and therefore can be used for pumps and liquid measuring apparatus in chemical factories. Parts can be made by extrusion methods.

In the United States, as has been said above, greater attention has been paid to alloys with aluminum, magnesium, and silicon, principally for use in airplanes. One recent writer has figured that if airplanes could be made of these very light alloys, an airplane now carrying a paying load of 4,500 pounds could be made to carry a load of 7,500 pounds. But little has been made public of the results obtained by investigators of these alloys.

Beryllium, although very light, is very hard, and will scratch ordinary glass. It has about the same strength as steel, and about the same elasticity; its melting point, 1,280° C., is about the same as cast iron, and it has about the same coefficient of thermal expansion. Beryllium is very avid for oxygen; it soon tarnishes in the air, and will perhaps find use as a deoxidant. For this reason, beryllium alloys are free of occluded gases (blowholes) and oxides. In making alloys, therefore, they must be made in an oxygen-free atmosphere. Beryllium, too, forms carbides and nitrides with the greatest ease.

There seems to be a distinct future for this metal. The raw material, beryl, is abundant, and if there was a large demand, it could be furnished cheaply. If a cheap process for the isolation of the metal is developed, we may expect it to become one of the commoner useful metals. Readers may obtain from The Review a bibliography on this promising metal.

George W. Noble

OIL AND GAS CHALLENGING HUMAN CONTROL. MARY SUDIK BLOWING WILD, APRIL 4, 1930

Organic Chemistry in X-Ray Diagnosis

PHYSICIANS are nowadays no longer under the necessity of making wise guesses relative to disarrangements inside of their patients. If their thumping, prodding, and poking give them grounds for suspicion, they withhold their judgment until they have looked to see. X-rays are a certain means of revealing fractures. They generally show abscesses and other growths. With the help of suitable adjuncts they show the position of the internal organs and the morbid conditions which may exist in them. They make hidden things obvious and have made diagnosis a matter of rigorous inference.

Dense matter, such as a bone or a stone of calcium urate, casts an x-ray shadow which may be recorded on a photographic plate. But the soft parts of the body give little or no shadow and appear as a formless blur. Adjacent

organs are thus indistinguishable from one another. If the physician wishes to make an x-ray photograph of the stomach or intestines, he gives the patient a drink of barium sulphate milk. The barium sulphate, which casts a strong shadow, outlines on the plate the form and position of the organs which contain it and yields what amounts to a shadow of the organs themselves. Similar methods are used for photographing other internal organs, but the methods are applicable only if the organs are in some way accessible from the outside of the body.

Stones in the kidney sometimes consist of calcium urate which casts a good shadow, but more often of uric acid and most frequently of cystine, which give no shadow at all. The physician, therefore, surrounds the stones with a medium which gives an x-ray shadow. He introduces a strong solution of sodium iodide into the kidney. On the photographic plate the stones appear as transparent objects surrounded by an opaque medium. The process of introducing the pyelographic solution by means of an instrument through the urethra and ureter is not pleasant for the patient, but until recently it has been the best that could be done. Morbid conditions in the organs not infrequently have made the use of the instrument impossible, and this has been in cases where the necessity for an accurate diagnosis has been most urgent.

Gall stones of cholesterol yield no x-ray shadow and have presented a difficult problem because the gall bladder is inaccessible from the outside of the body. Compounds of iodine, however, are known to be opaque to x-rays. Organic chemistry has supplied a compound, tetra-iodo-phenolphthalein, which, when injected intravenously, collects in the gall bladder and makes it possible to secure a clear-cut picture of any stones which may be present. This aid to diagnosis has been in use for several years.

The most recent achievement in this field, scarcely a year old, is the use of an organic compound of iodine for x-raying the kidney and bladder. The sodium salt of iodo-oxy-pyridine-acetic acid, if injected intravenously, goes to the kidney and bladder and makes it possible to secure photographs without the use of an instrument in the organs themselves. If the intravenous injection is not altogether pleasant for the patient, it may be that the organic chemist will some day be able to find some substance for the same purpose which may be taken through the mouth in a glass of milk or ginger ale.

Sulphur in Soap

ORDINARY sulphur frequently produces a skin irritation that precludes its use in soap and reduces its effectiveness as a skin remedy. A new type of sulphur, the by-product of the thylox process of gas purification, seems to be free of these undesirable properties; in fact, it seems to possess unusual qualities that commend it to manufacturers of insecticides, fungicides, and soaps.

Thylox sulphur is of a colloidal nature, an exceedingly fine grade of pure sulphur derived from the hydrogen sulphide in coal gas. The idea that it might be advantageously used in soap was hit upon during a toxicological investigation of the thylox purification process by the Koppers Research Corporation. It was noticed by the investigator, Dr. Emery R. Hayhurst, of Ohio State

Galloway

ARCHITECTURE BY TWILIGHT. CENTER: NEW YORK "DAILY NEWS" BUILDING. RIGHT: CORNER OF CHRYSLER BUILDING

University, that some of the workmen were using the by-product sulphur as a hand cleanser. When questioned, they claimed that it had excellent cleansing qualities, and that it seemed to be beneficial to the skin of those who were exposed to salt solutions encountered in the processes. The Koppers Research Corporation thereupon began to experiment with the sulphur as a detergent combined with a soap base. Once the soap was made, Dr. Hayhurst investigated its uses and effects. From his preliminary study he concluded that the soap is unusually bland in its effects on the normal skin, including the scalp. He further found that the soap has prompt, beneficial and even curative effects on the simpler forms of skin diseases, and that it has pronounced preventive and curative properties in certain occupational dermatoses, such as platers' rashes, "machinists' boils," and the like.

While the thylox sulphur may be used as a paste, ointment, or powder, its successful use as a detergent in soap is noteworthy and commands particular attention as a preventive of occupational dermatitis.

Temperature According To Whims

MANUFACTURED weather which would make a home in the tropics cool and comfortable is now a possibility. Cooling systems such as those used in theaters, department stores, hotels, and other buildings for public use, can now be installed in the home. Already several concerns producing mechanical refrigerators have announced small air conditioners for home use.

In these robot weather-makers, inventors endow a single machine with ability to control humidity as well as temperature. In this process the air is washed, chilled or

RELIEF PHOTOGRAPH OF THE HALF DOME, YOSEMITE VALLEY, TAKEN BY PAUL F. JOHNSON, '98. THE RELIEF EFFECT IS OBTAINED BY OFFSETTING A NEGATIVE SUPERIMPOSED UPON ITS OWN WHITE PRINT

heated, and humidified. The necessary equipment for this unit are fans for moving the air, refrigerating machines or heaters for tempering it, and pumps to provide sprays for cleaning and humidifying it. One typical home unit is designed to condition air for a room of 300 square feet of floor space, occupied by not more than six persons. Varying with conditions, this unit will lower the temperature of the room about 10° F. and the humidity 10% representing a 15° F. sensible lowering of the temperature. Air is taken in from near the floor, is passed over an evaporator kept at 40° F., cooled below the dew point, and excess water vapor is precipitated. The air, slightly warmed, is then sent into the room. The readiness with which people accept other devices for the home presages the future of this.

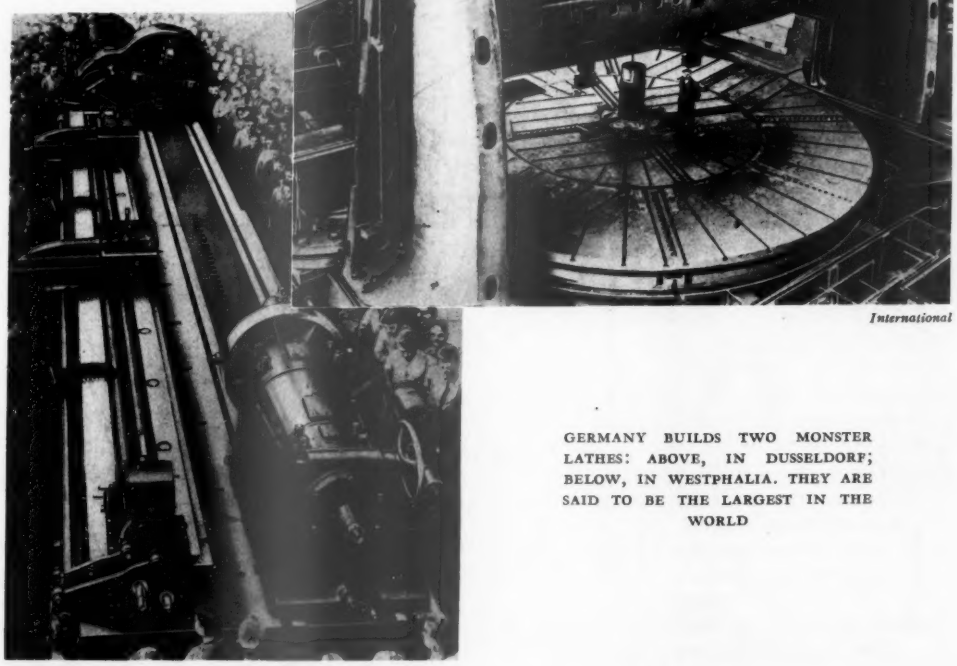
Dam of Dams

CHAPTER one of the enterprise to control the Colorado by damming it in the gorge of Black Canyon opens next month in Denver. There, on the second anniversary of Hoover's inauguration as President, in the office of the United States Bureau of Reclamation are to be opened bids for building Hoover Dam.

A decade of foreword and preface writing has culminated in placing a table of contents and synopsis in the hands of contractors six months ahead of time and, in the considered words of the customarily restrained editors of the *Engineering News-Record*, they are "plans and specifications of rare perfection." It is now evident, continue the editors, that Hoover Dam, which "has been thought of as excelling chiefly in size," is the "most advanced, the boldest and most thoroughly studied hydraulic enterprise in history."

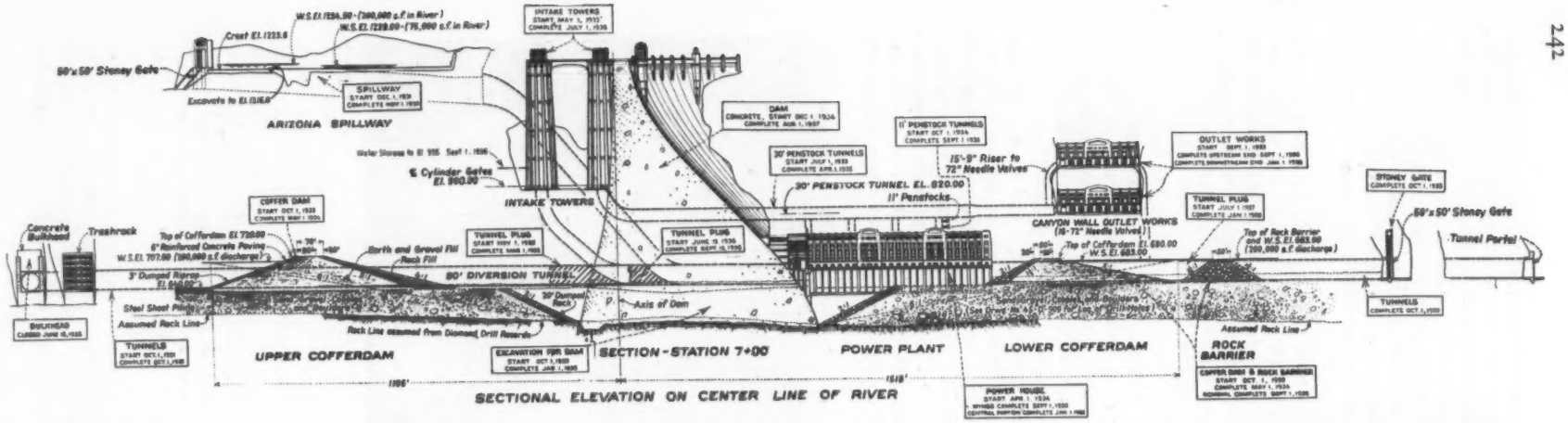
Should all go well on March 4, an award may be expected before the lapse of another month and by midsummer the seven-year program of putting 135,000,000 cubic feet of concrete and 35,000,000 pounds of reinforcing bars and rails into their assigned places, and for attending to such fantastic quantities as 70 miles of grouting holes, 28 miles of copper water stops, and 2,035 tons of needle valves, can get well under way. The Government's wish is to include in a single contract diversion tunnels, coffer and main dams, spillways, intake and outlet works as well as an inclined freight elevator on the Nevada side of the river.

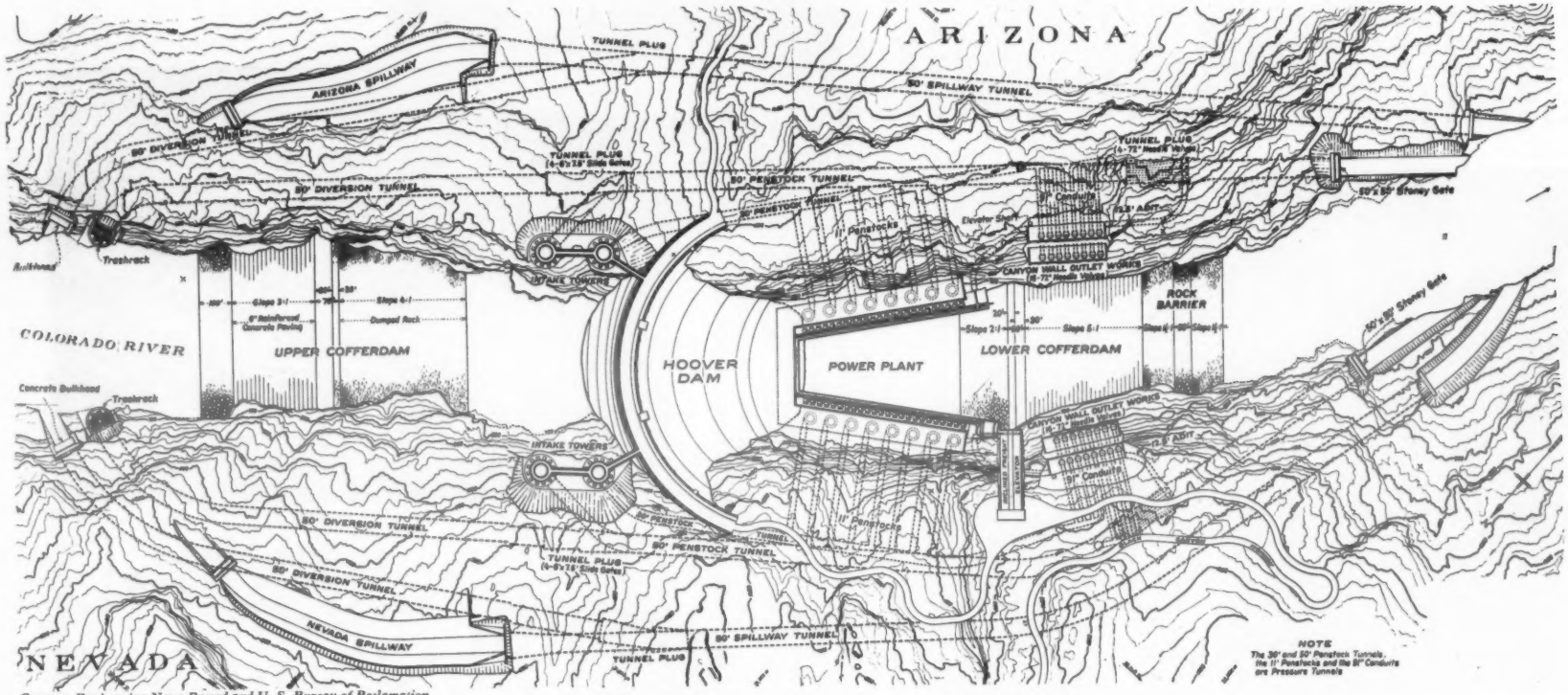
The Review for March, 1929, noted that a board of geologists and engineers, of which Dr. Charles P. Berkey of Columbia was a member, had, after a painstaking and official study, indorsed the general practicability of what was then called the Boulder Dam project. They recommended, however, that foundation loads be 30 tons per square foot rather than 40. Their wish prevailed and the



International

GERMANY BUILDS TWO MONSTER LATHES: ABOVE, IN DUSSELDORF; BELOW, IN WESTPHALIA. THEY ARE SAID TO BE THE LARGEST IN THE WORLD





Courtesy Engineering News-Record and U. S. Bureau of Reclamation

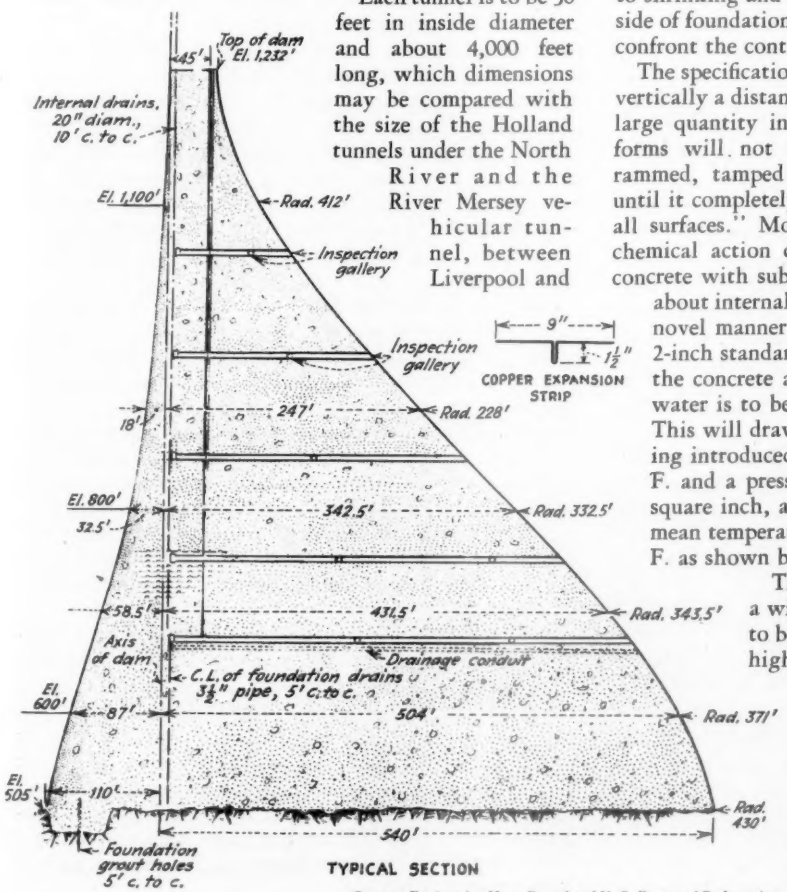
PLAN AND LONGITUDINAL SECTION OF THE BOULDER CANYON PROJECT

designs upon which contractors are now preparing estimates have been passed upon favorably by the same board.

Except for certain details which may not be determined until after construction begins, the present designs are indicative of what one may expect to come upon if during the next few years he moves about in the vicinity of that newest of boom townsites whose coming occupancy was mentioned in these columns last November. Now, on the maps furnished to contractors, it is Boulder City, Nev., a community guaranteed a thriving existence until 1938 at least, for it is to be the GHQ for the builders of Hoover Dam. The drawings on page 242 disclose by plan and longitudinal section the various dates of the operations schedule. Spillway and diversion tunnels are to be ready two years from next autumn; coffer dams late in the following spring. A start on placing concrete in the dam itself is due in December, 1934; impounding water is to begin by June, 1936; power is to be generated commencing in September, 1936.

Except for spillways, much of the work until the late summer of 1933 will be underground, preparing to divert the river through four concrete-lined tunnels all on the same level. Later, after serving as diversion tunnels, these bores are to have permanent duties: two as penstocks and two as the lower ends of the spillway discharge system.

Each tunnel is to be 50 feet in inside diameter and about 4,000 feet long, which dimensions may be compared with the size of the Holland tunnels under the North River and the River Mersey vehicular tunnel, between Liverpool and Birkenhead, England. The two Holland tubes are 29 feet in exterior diameter and 1.61 miles in length; the Mersey tube has an inside diameter of 44 feet and its total length, including two branches on each side of the river for entrance and exits, is 2.93 miles. Upon completion this year the Mersey tube will be the largest circular tube tunnel in the world and its two roadways, an upper and lower, will accommodate six lines of vehicle traffic and two foot-walks.



TYPICAL SECTION

Courtesy Engineering News-Record and U. S. Bureau of Reclamation

SECTION OF HOOVER DAM. SEE OPPOSITE

With the Colorado directed into the four diversion tunnels, building the coffer dams and excavation for the Hoover Dam proper are to start. The latter is of an arched form suited to the steep-sided canyon location with hard rock walls. On the axis its radius is 500 feet. From the lowest foundation point to the crest it will measure 730 feet and the length at the top will be 1,180 feet. Mathematical analysis and model tests have been exhaustively applied to provide a design to withstand the lateral action of likely loads on the upstream face of the dam due to action of impounded water on its arched form.

Massive columnar prisms of concrete 50 feet square in plan are to form the integral parts of the dam. Upstream and downstream vertical faces of these prisms will be curved on the alignment of the dam; the radial joints will be keyed and afterward grouted under pressure to create a solid arch. This method is expected to avoid cracking due to shrinking and thus cope with a difficulty which, outside of foundation problems, is one of the most serious to confront the contractors.

The specifications provide that "dropping the concrete vertically a distance of more than five feet or depositing a large quantity in one place and working it along the forms will not be permitted. All concrete shall be rammed, tamped or worked with suitable appliances until it completely fills the forms or fits snugly against all surfaces." Moisture change and heat generated by chemical action during the setting of large masses of concrete with subsequent cooling and contraction bring about internal stresses which are to be dealt with in a novel manner. Cooling ducts (800,000 linear feet of 2-inch standard pipe and fittings) are to be placed in the concrete and through this network refrigerated water is to be circulated during the setting process. This will draw off the heat — the cooling water being introduced at a temperature of not less than 35° F. and a pressure of not more than 100 pounds per square inch, and circulation is to continue until the mean temperature around each pipe is reduced to 72° F. as shown by embedded thermometers.

The power house is to be U-shaped with a wing on each canyon wall. Each wing is to be 500 feet long, 66 feet wide and 85 feet high from generator floor to roof. After notice to begin work the contractor is allowed 1,600 days to complete the wings, including six units apiece and foundations for two remaining units. On this, and all subdivisions of the work, damages to the amount of $3,000 per diem are to be assessed the contractor for delays. Once coffer dams are completed the government assumes the flood damage risks.

BOOKS

Scientific Book Club Selections

BY special arrangement with the Scientific Book Club, Inc., The Review is to present each month a list of books selected by that body as meriting the careful attention of all who desire to keep abreast of scientific thought. The selections are made by an editorial committee consisting of Arthur H. Compton, Edwin G. Conklin, Kirtley F. Mather, Harlan T. Stetson, and Edward L. Thorndike.

For January the principal selection was:

AFRICA VIEW, by Julian Huxley. $5.00. 466 pages. New York: *The Scientific Book Club, Inc.*

" . . . a record of a visit of four months to the East African Territories of Uganda, Kenya, Tanganyika and Zanzibar with a dash into the Belgian Congo. But it is more than the usual book of travel and adventure in strange lands, for it is written by a distinguished biologist (grandson of Professor T. H. Huxley) who was sent out by the British Colonial Office Advisory Committee on Native Education, and consequently it is a popular work dealing with many topics in a scientific manner.

"Its author has deliberately adopted the method of interspersing a diary record, based on his daily notes, with chapters on particular topics, thereby retaining vividness and variety without sacrificing the solidity of ideas which reflection crystallizes from many isolated experiences. While fluent and conversational, he has given due regard to scientific accuracy. Indeed, in ability to make science popular, the mantle of the grandfather has fallen upon this grandson. . . ."

Other highly recommended books obtainable from the S. B. C. are:

RACE PSYCHOLOGY, by Thomas R. Garth. $2.50. 246 pages.

THOMAS SAY, EARLY AMERICAN NATURALIST, by Harry B. Weiss and Grace M. Ziegler. $5.00. 260 pages. Illustrated.

WORLD MINERALS AND WORLD POLITICS, by C. K. Leith. $2.00. 193 pages. Illustrated.

ANDRÉE'S STORY, edited by The Swedish Society for Anthropology and Geography. $5.00. 400 pages.

AMBER TO AMPERES, by Ernest Greenwood. $4.00. 344 pages. Illustrated.

Keeping the Mind Healthy

INTRODUCTION TO MENTAL HYGIENE, by Ernest R. Groves and Phyllis Blanchard. $4.00 (Student's edition $3.25). 467 pages. New York: *Henry Holt and Company.*

ON those rare occasions when a college student commits suicide, the more vapid representatives of the daily press, a category in which too many newspapers can be included, invariably ascribe the calamity to "overstudy." If newspaper owners were sensible enough to employ psychiatrists to advise and instruct their news writers, and if editors would read a few authoritative books on mental hygiene, they might have a more reasonable conception of this and other problems.

Suicide is generally the product of a disordered personality. It is usually caused by no immediate traumatic event, but results as the culmination of a long series of mental strains and emotional stresses. The individual prone to the suicidal mania is likely to indulge in it whether he happens to be a college student who chooses thus to embarrass the university authorities, or whether he is an old grad, or merely an obscure tradesman in a depressing environment.

Progressive colleges are beginning to realize that mental hygiene is a necessary part of their administration and instruction. As is well expressed in the engrossing chapter in this book on mental hygiene in the college, this recognition has come not because mental diseases are rampant in universities, but because the institution has a definite responsibility as a possible distributor of the accepted principles of mental hygiene. The science is applicable, incidentally, not only to students but also to faculty members, some of whom would profit greatly from psychiatric attention.

This book is concerned, however, with many more phases of the comparatively new science of mental hygiene than its operation in the college. The book is, in fact, a brilliant exposition of every aspect of mental hygiene as it applies to childhood, adolescence, delinquency, marriage, the school, business and industry, religion, social work, and every-day life. There are particularly interesting chapters on mental hygiene in literature, and in its relation to public opinion, especially as it affects and is influenced by the sensation-mongering newspapers with which we are now and always have been afflicted.

Although somewhat pedantic in parts, having been obviously prepared as a text book, this work is unquestionably one of the most able and absorbing of the whole profuse and copious collection of books which are, or are alleged to be, devoted to the popular subject of mental hygiene. This volume is not one of the personal, self-help kind, which is now so prevalent. Instead, it is an explanation of the scope of mental hygiene and how it operates in connection with the various aspects of life. Any reader with any vestige of intelligence could, nevertheless, easily see the personal applications, and most persons ought to be able to apply them without undue difficulty.

A book such as this, prepared by two competent sociologists expert in psychology, ought to be widely used as a college text book, and it also deserves popular favor with the general lay reader. Mental disorders are, as a rule, just as preventable as are physical, but it is only by proper knowledge that they can be prevented. The book is well printed, has a good index, and is supplied with many useful bibliographies. It is to be highly recommended for serious and at the same time entertaining perusal by all persons who desire real information on this most important subject.

JAMES A. TOBEY

WILLIAM BARTON ROGERS
DEC. 7, 1804 — MAY 30, 1882
PROFESSOR OF NATURAL PHILOSOPHY AT THE
UNIVERSITY OF VIRGINIA
1835 — 1853
FOUNDER 1859 AND
PRESIDENT 1865—1870, 1878—1881 OF THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
IN WHOSE MEMORY
THIS TABLET IS PLACED BY THE
VIRGINIA ALUMNI OF THE INSTITUTE
—DEC. 7, 1930—

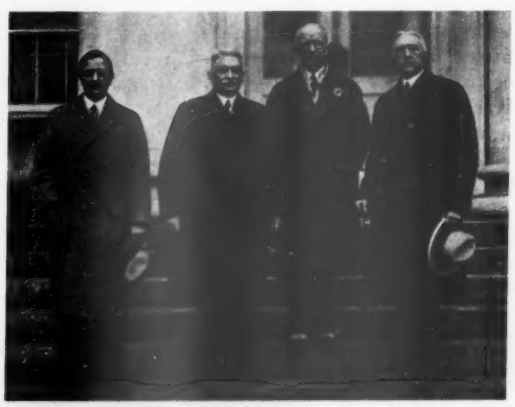
A MEMORIAL TO ROGERS

The Founder of the Institute Is Honored at the University of Virginia

By Lauren B. Hitchcock

FOUR men sat beneath a picture. One of them was Samuel Wesley Stratton, Chairman of the Corporation of the Massachusetts Institute of Technology; the second, Edwin Anderson Alderman, first president of the University of Virginia (prior to his accession, the University was headed by the Chairman of the Faculty); another, J. Scott Parrish '92, President of the Technology Club of Virginia; the fourth, Llewellyn G. Hoxton, senior physicist at the University of Virginia. Their common interest was the memory of William Barton Rogers; the occasion, dedication of a bronze tablet on his 126th birthday.

The canvas bears the likeness of an old gentleman who must have been mentally alert, hard-working, yet above all, serene. The name plate describes him as one who was professor of natural philosophy at the University of Virginia from 1835 to 1853, nothing more. Perhaps when the painting was hung in the Chemical Laboratory in 1881 the true significance of his other achievements had not been recognized. Nearly 50 years of chemical atmosphere had almost obscured his features when the Technology Club of Virginia recently discovered this fading memorial, inadequately identified to most of its beholders. They decided to place a tablet beneath the portrait, setting forth as simply as possible the principal achievements of the subject — William Barton Rogers.



AMONG THOSE PRESENT AT THE DEDICATION. LEFT TO RIGHT: DR. L. G. HOXTON, DR. S. W. STRATTON, MR. J. SCOTT PARRISH, AND PRESIDENT EDWIN A. ALDERMAN

With the approaching exercises of presentation but a few weeks off, it became apparent that the picture was not in appropriate condition. Almost sole relic of the old chemical laboratory which burned to the ground in 1916, the canvas was blackened and torn. The Art Commission of the State of Virginia dispatched it to Cambridge, Mass., where the J. F. Olsson Gallery performed a work of restoration which seems incredible to those who knew the picture. Today, resplendent in new gold leaf and safely sealed under glass from laboratory fog, Dr. Rogers is prepared to gaze benignantly over the heads of future generations.

Thus it happened that on December 7, 1930, in the presence of a notable gathering at the University of Virginia, Mr. Parrish unveiled the metal plaque, bearing a brief but permanent statement of facts familiar enough to us today. In presenting it on behalf of the Technology Club of Virginia, he said:

". . . it was here that he spent 18 years of his life; it was here that he received the great inspiration to found the Massachusetts Institute of Technology at Boston. We think of what that institution has done, and of the

(*Continued on page 258*)

THE INSTITUTE GAZETTE

Annual Dinner

PLANS under way for the Annual Dinner of the Alumni Association to be held at the Hotel Statler, Boston, on February 28, indicate that it will eclipse any dinner held for many years. The Institute is to present in the rooms adjacent to the Statler ball room a series of important exhibits, and prior to the dinner there is to be a reception at which the Alumni will have an opportunity to meet Dr. Stratton, President and Mrs. Compton, and other representatives of the Faculty and Corporation.

Ladies are invited to the dinner and Alumni are urged to come accompanied. A dance will cap the evening.

Corporation News

AT THE meeting of the Institute's Corporation on January 9, three life members were elected to that body: John R. Macomber, '97, President of Harris Forbes and Company, Inc., Albert H. Wiggin, Chairman of the Board of the Chase National Bank of New York, and Alfred L. Loomis, banker and physicist of New York. Biographical sketches of each of these new life members will be presented in the March issue of The Review.

At the same meeting Mr. Macomber was appointed to the Committee of Finance; Mr. Gerard Swope, '95, President of the General Electric Company, and Mr. Arthur D. Little, '85, President of the Arthur D. Little, Inc., were appointed to the Committee on Membership; Godfrey L. Cabot, '81, was appointed Chairman of the Visiting Committee on Humanics; and to the Committee of Hygiene, Lammot du Pont, '01, and William R. Kales, '92. The jurisdiction of this last committee was extended to cover athletics at the Institute.

Reports of progress were made by the visiting committees of the Departments of Naval Architecture and Marine Engineering, Electrical Engineering, Business and Engineering Administration, and the Division of Industrial Coöperation and Research. Twenty-two advanced degrees and 52 degrees of bachelor of science in various branches of engineering were approved by the Corporation at this meeting.

It was announced that Igor N. Zavarine, S.M., '20, of the Department of Mining and Metallurgy had been promoted to the grade of assistant professor in that department. He is a member of the American Institute of Mining and Metallurgical Engineering, the American Institute of Mechanical Engineers, the American Society for Steel Treating, the Iron and Steel Institute, and the Institute of Metals of Great Britain. The resignation of Professor Henry O. Forrest, '20, of the Department of Chemical Engineering, and Director of the Research Laboratory of Applied Chemistry was also announced. Professor Forrest is to join the M. W. Kellogg Company, manufacturers of oil refining machinery, and is one of a large group of Technology men who have recently been called to leading industrial positions. Professor Leroy F. Marek, a graduate of the University of Texas, and a member of the Chemical Engineering Department, was appointed Acting Director of the Laboratory of Applied Chemistry to succeed Professor Forrest.

Alumni Seminars

AS ANNOUNCED by Dr. Compton at the dinner of the Technology Club of New York on December 8, and as recorded in the last Review, a series of Alumni seminars have been started in New York. The first of these, devoted to electrical engineering, was held at the Technology Club of New York on January 12, when Professors Dugald C. Jackson, Vannevar Bush, '16, and Edward L.

M. I. T. Photo

INTRAVENOUS INJECTION IN THE INSTITUTE'S LABORATORY OF STEAM ENGINEERING AND HYDRAULICS

Bowles, '22, represented the Institute. The seminar plan as worked out by the New York Technology Club together with Dr. Compton embodies a series of professional conferences each led by representatives of the Institute's Faculty. Beginning at 5:15 in the evening at the Technology Club, there will be an hour session followed by dinner. At each table of six will be a chairman who will "get from his group a single topic or question and will epitomize the thoughts and reactions of those at his table on the questions of the evening." After dinner the group will reconvene and the professors present will take up in succession the topics presented by the table chairmen.

The Technology Club has so planned these dinners that the charges are very moderate. For members of classes later and including 1920, the charge is $1.25; for those previous to 1920, $2.50. The next seminar, devoted to architecture, comes on February 2; the next, devoted to chemistry, on March 9.

Chinese Students Directory

WITH laudable initiative the Chinese Students Club at the Institute has prepared and issued a directory of Chinese students who have registered at Technology since its establishment. Nearly 400 Chinese are listed in this illustrated directory. Of these, 350 have returned to China since leaving the Institute. Seventeen of those listed have doctor's degrees from the Institute.

The first Chinese student to register at Technology appeared in 1877. The largest Chinese registration on record for any single year was 60 in 1921. Electrical engineering has claimed the largest number of these students, with mechanical, chemical, and civil engineering following in succession.

Class, course, thesis, and alphabetical classifications are presented in the book, together with notes on the activities at the Institute and in China of the men listed.

New Rating System

THE Faculty has recently adopted for a trial period a new scholastic rating system so that parents and students may clearly understand the standards which govern the rating of a student's record. This system is based on the results of three years' experimental study of the records of recent classes. The scales of minimum scholastic standards provide for:

1. Immediately eliminating the student who completely neglects to take advantage of his educational opportunities,
2. Warning and eventually eliminating the student who previously has been doing satisfactory work but who is now failing through lack of ability or loss of interest,
3. Warning and eventually eliminating the student whose cumulative performance is below a required quality, and
4. Giving further opportunity to the student whose cumulative record is below standard but who is now improving.

A Committee of Appeal will furnish the necessary elasticity to the system, its function being to waive the application of the rules in those cases where non-academic reasons, such as sickness, have interfered with the student's work, the student being required to explain the reasons for the interference.

A further study of the scholastic rating system is being made to determine at what stage in the technical school training it is established that certain students have exceptional ability in either science or engineering; which methods of instruction will insure a mental effort on their part, at least comparable to that of the average student, so as to develop their minds and accelerate their progress in their chosen fields; and finally to decide what awards should be offered as incentives to scholarships.

T. Coleman du Pont (1863–1930)

"ABILITY measured by results" was the favorite maxim of T. Coleman du Pont. That this maxim was a workable and guiding principle has been surely demonstrated by the panorama of achievements which made up the life of this industrialist. His is the biography of the man of action — the master builder in the world of affairs. In du Pont's estimation, a man's worth is measured by his accomplishments and in this sense his life has more than reached the standards which he expected of others.

Let us look for a moment at the chain of events marking the life of a successful man. Unlike his famous relatives, Coleman du Pont had to make his own way in the world, unaided by family prestige and without financial support. He was born in Louisville, Ky., December 11, 1863, where he received his early education. Later he entered Chauncy Hall School but was forced to return home for financial reasons. He then went to work in the mines of Central City, where he actually dug coal, drove mules, and served for a time in a blacksmith shop. Having worked there two years, he came to Technology, leaving in 1883 after three years of training in mining engineering. On his return to Central City he became first a mining engineer and then superintendent in the mine in which he had been a laborer. During this period he took an unusual interest in remodeling the city into a well-organized community. Such was his zeal in this behalf that Central City grew from a struggling village to a town of 7,500 inhabitants, a pleasant place to live with comfortable homes, modern conveniences, and a correspondingly increased civic pride. This was no small achievement and such a career in itself would have satisfied the ordinary business man. Coleman du Pont, however, had that in his make-up which urged creation. Once an organization was on its feet in smoothly running order, his interest waned and he was looking for new worlds to conquer, with all the ambitious enthusiasm of the boy Alexander.

We hear much today about the American capitalist and the spirit of American industrialism personified in its leading magnets. Although these men are decried as "materialists" there is a mysterious, intangible romanticism in their love of the material. Back of this outward manifestation is a real philosophy in which they believe as sincerely as any academic philosopher. Carlyle has called it the "work philosophy" and it is suggested by him as the salvation of mankind — work in the right direction toward a goal worthy of attainment. The work

of such far-seeing men as du Pont is but a means to an end just as the money earned is but the tool of the brain which produced it. The romance lies in the beauty of construction, the desire to build worthy things — and no man can judge whether it is better to build a much needed highway for the material welfare of society or to think out the world's problems in prose and verse. Let each man to his own taste.

Du Pont might easily have been the model for the character Uncle Sam drawn most skillfully by John Erskine and presented to the public in his book, "Uncle Sam in the Eyes of His Family." Here is a sympathetic picture — a composite picture of the American captains of industry — of just such men as du Pont. There is in him a goodly portion of the less tangible Uncle Sam — the traditional personality of America.

From mining he turned to steel — the foundation of modern construction. Not long content to be general manager of the Johnson Company steel mills he branched out for himself, going back to Kentucky where he became the president of three mining companies. His success in steel and transportation lines was so great that he retired and bought extensive farm lands in Maryland and Delaware, took up residence there, and began to conduct scientific farming on a large scale.

About this time the head of the du Pont de Nemours Company died and his sons asked their cousin Coleman to take over the business with them. In 13 years he increased the volume of business from $10,000,000 annually to over $200,000,000 and the number of employees in the main office from seven clerks to over 3,000. When the war came, however, du Pont resigned the presidency, as the manufacturer of munitions for war purposes was distasteful to him. Although half of the powder used by the government is made by this company, it formed only one per cent of their business prior to the European war. Most of the output was used for blasting in construction, mines, quarries, and tunnels. Today this company makes nearly 300 different commodities, the result of Coleman du Pont's theory that new values in materials would fill in the gaps of declining powder sales.

Enthusiasm for good roads and an appreciation of their benefits to all classes of industry led him to build a model road through the state of Delaware, a project costing some $2,000,000 and which he supervised and organized with characteristic energy. Today it stands as a worthy monument to a public-spirited industrialist.

The political aspect of du Pont's career was but another outlet for his amazing energy. He was the recognized Republican leader of Delaware, in which state he was chairman of the Republican State Committee for a considerable period. He held the rank of brigadier general by appointment of the governor, and from 1904 to 1924 he was a member of the National Committee, being in charge of the speakers' bureau of the national organization in 1908. In 1921 he accepted an appointment as United States Senator and two years later he was elected for the 1925–1931 term, resigning in 1928 on account of ill health.

After leaving the Powder Company, du Pont, ever restless, conceived the idea of building the greatest skyscraper office building in New York. This urge to build on a large scale, constantly persisting throughout his life, produced the Equitable Building. The completed structure was sold to buy the building's largest tenant, the Equitable Life Insurance Company, which he promptly mutualized for the benefit of its policy holders. This enterprise well established, he sold the business to the stockholders and entered the hotel business.

During all this time Coleman du Pont retained an active interest in the affairs of the Institute. This phase of his activities was described in the January issue of The Review. Perhaps no alumnus is more truly representative of what Technology training actually means, and there are few more generous in their evidence of loyalty. "General du Pont's behind it" was a famous by-word and one never was certain in what direction his dominating energy might break out. Du Pont was responsible for locating the Institute in Cambridge. In face of the opposition of the Selecting Committee to its location on the Charles, he purchased the land personally. When the committee eventually voted to buy the site originally rejected, he presented the deed without their knowing who the donor was. The value of the land meanwhile had increased by $300,000. This is but one instance of his generous nature.

It must have been difficult for a man with so much vitality to be tied down by ill health, for du Pont suffered from serious throat trouble for several years before his death on November 11, 1930. In 1927 he underwent an operation which necessitated the removal of the greater portion of the larynx, which deprived him of natural speech. A clever voice-recreating mechanism was substituted to permit him to talk in a monotone.

Having thus surveyed the activities which have made du Pont an important personality in America, it might be well to pause and reflect on the meaning of such a life. As we judge characters in a play partly by the opinions expressed by their fellow players, so we may learn something of the individual from what others have said of him. He has frequently been characterized as "an American Pepys in Wall Street." He has also been termed the Roosevelt of big business, for like him, du Pont was a man of lively physical activity, capable of doing many things at one time. An alert person of this temperament, who does whatever he sets his mind to and does it well, is everywhere respected and admired.

Some of his own opinions reflect admirably the trend of his life. "A man may be measured by the way in which he bears success," says Mr. du Pont. "Most of us can manage to bear adversity, whereas a bumper success often ruins us." Again, he speaks in praise of common sense (an uncommon quality, by the way) as an indispensable element of success, showing itself time and again in good judgment and sound decisions. This quality, combined with uncompromising honesty and hard work, makes up du Pont's favorite "success formula." In the light of these remarks we can readily appreciate another of his emphasized points: "Men make an organization, not its bricks or its machinery." Du Pont, moreover, knew how to select men whom he could trust with full responsibility. As no man can possibly be everywhere and into everything in person, keenness in selecting worthy representatives is a distinguishing mark of the successful man. His friends knew him as a hearty, good-natured man, of pleasing personality, tactful and understanding.

WHAT IS THE

A·T·&·T·?

ALL that most people see of the telephone company are a telephone and a few feet of wire.

But through that telephone you can talk with any one of millions of people, all linked together by the web of equipment of the Bell System.

All its efforts are turned constantly to one job —to give better telephone service to an ever-increasing number of people, as cheaply as it possibly can.

The American Telephone and Telegraph Company provides the staff work for the Bell System. To it the operation of the telephone service is a public trust. It pays a reasonable dividend to its stockholders . . . and uses all earnings beyond that to improve and extend the service.

There are more than five hundred and fifty thousand stockholders, and no one person owns so much as one per cent of its stock.

The Bell System operates through 24 regional companies, each one attuned to the needs of its particular territory. In addition, the 5000 members of the Bell Laboratories staff do the scientific work which makes it possible to improve and widen the service at least cost to its users. The Western Electric Company, which manufactures for the Bell System, specializes in the economical production of telephone equipment of the highest quality.

All these facilities are directly available throughout the entire Bell System, at any time or place. . . . Because of them, every dollar that you spend for telephone service brings you constantly greater value and convenience.

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★

SCIENCE ENDANGERED

(*Concluded from page 228*)

inspiring understanding of what all this scientific discovery and progress is about? Too often he asks for the bread of interpretation and is given only the stone of minute experimentation.

It would indeed be a cruel fate if the natural and experimental sciences, after their full half century of increasing educational dominance and with their quite unlimited educational possibilities, were now to be sent the way of the ancient classics, and should come to be generally used and known only in their applied and technical aspects, primarily for economic reasons and from motives of gain.

"O, what a fall was there, my countrymen!"

If the natural and experimental sciences are to escape this fate, those who teach and who represent them in the academic life of the world must be able to follow the example of a Huxley and a Tyndall, of a Helmholtz and a du Bois-Reymond, of a Pupin and a Millikan, of an Eddington and a Jeans, and those like-minded and like-spirited with them, who can and will interpret the facts, the findings, the methods and the lessons of the natural and experimental sciences to that multiplying host of intelligent men and women who seek a liberal education in the true sense of that term. Narrowly limited specialization between mounting walls of closely restricted interest, knowledge and skill will not do. That way lies the path to the academic graveyard.

INVENTION AND ECONOMICS

(*Continued from page 234*)

many varieties and could not be dealt with as a homogeneous mass, developed analytical concepts to deal with labor of various ranks and grades. By such means it is possible, on rational grounds, to account for variations in the rate of wages in different types of occupations. But all this depended on the assumption that the employer could, at least in rough-and-ready fashion, estimate the value to his enterprise of the services of a particular class of workers. Now, due to the highly fortuitous and unpredictable nature of innovation, no such estimation is in general possible, so that conventional wage theories cannot in the nature of things take adequate account of it.

The early Greeks, is so far as they thought at all about what we now call production, regarded it as an act of drawing upon the bounty of the gods. They made, perhaps fortunately, no analysis of factors of production coöperating to turn out a product. Consequently they recognized no necessary connection between the hours of toil and the extent of the product. Their idea appears to have been that the gods, having made their bounty available for the sustenance of mankind, had also in their wisdom so arranged things that man should have to do a little searching and contriving on his own account, lest life become too idle and easy. Now, making all due allowance for the fact that this was only the mythological tradition of a simple agricultural people, there is a germ of truth in it which may fit the (*Continued on page 252*)

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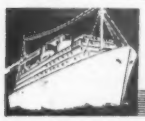

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INVENTION AND ECONOMICS

(*Continued from page 250*)

present economic status of innovation better than more sophisticated theory. The useful products which we enjoy are not merely the result of so many hours of treadmill labor, aided by appropriate instruments. We do not so much create utilities as draw them up out of an inexhaustible reservoir which we are only now beginning to learn how to tap effectively. Mr. Edison's oft-quoted epigram to the effect that invention is one per cent inspiration and 99 per cent perspiration may be quite true so far as concerns the inventor himself. There is no immediate prospect that work will be abolished. The significant thing is that the final product, in amount and quality, bears no fixed or definite relation to the amount of toil spent upon it by the population as a whole. The game is primarily one of outwitting nature, and the perspiration, though profuse, is after all only incidental.

The main stream of economic thought since the days of Adam Smith has followed a course quite different from that indicated either by the Greek view or by Sir William Petty as I have interpreted his suggestion. The Father of Political Economy was concerned with a different range of problems as a glance into the "Wealth of Nations" will show. He says, for example, "the improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labor, and which, though it costs a certain expense, repays that expense with a profit." Again, supposing the case of a dyer who knows a process which enables him to dye cloth at half the usual cost, "his extraordinary gains arise from the high price which is paid for his private labor," but "they are commonly considered as extraordinary profits of stock. Such enhancements of the market price are evidently the effects of particular accidents, of which, however, the operation may sometimes last for years together."

In these passages art seems reduced to mere manual dexterity, though Petty evidently had in mind some more ample achievement in dealing with a stubborn environment. Again, with the easy advantage of hindsight, it now appears that innovations in technique represent something more than particular accidents. It is hardly gracious to pick flaws in Adam Smith because he could not foresee the course of organized research as we know it today. What the old master was trying to do was to fit into his threefold distribution scheme of wages of labor, rent of land and profits of stock, a phenomenon — innovation — which even in his day was getting to be troublesome. Since then it has proved more and more refractory to economic analysis as the scope and influence of research has widened. Were Adam Smith alive today, he would be casting upon our laboratories that shrewdly philosophic eye which rested (*Continued on page 254*)

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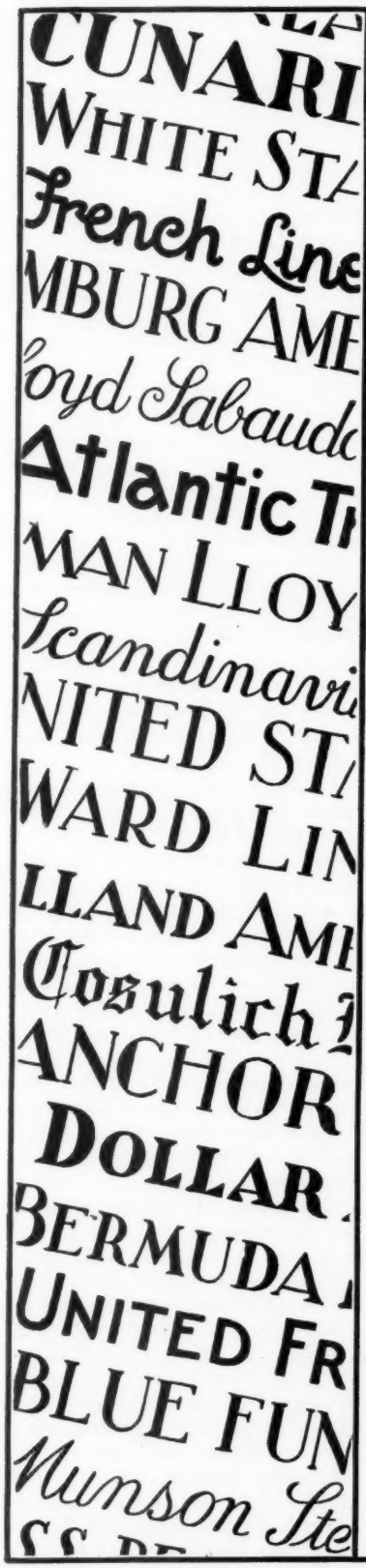

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INVENTION AND ECONOMICS

(*Continued from page 252*)

to such good purpose upon an eighteenth century pin factory. Where, in his age, he brought away sound and permanent conclusions regarding the division of labor, he might, in our age, deal as perspicaciously with, let us say, the General Motors Research Corporation. The laboratories are brewing social and economic problems out of technical elements, so that the Adam Smiths of our century will find there plenty of work ready to hand.

The relation of innovation to economic profits is perhaps the most fascinating of all the wide range of topics included under the economics of invention. It can hardly be discussed without reference to the static analysis, with which the economics of the past century has been primarily concerned. In attempting to solve the riddle of how the value of goods and services is ultimately determined, and how the national dividend is distributed, it has become necessary to make increasingly artificial assumptions in order to bring the problem within reach of rigorous logic. Chief among these has been the assumption of a static state of society in which competition works out its effects to equilibrium, unhindered by friction; in which population and habits of consumption remain constant; and in which innovations in the arts of production cease to intrude their disturbing influences. In fact, the phrase "given the state of the industrial arts" runs like a refrain through most of the economic analysis of the past generation. Under these assumptions, the famous "tendency of profits to a minimum" works itself out to completion in such a way that no business man could hope to make more than the wages his services would command in the employ of another.

These highly artificial assumptions have justified themselves in practice by yielding a number of conclusions both interesting and useful. An extensive body of criticism has grown up, however, which takes the view that dynamic influences, of which technical innovation is one, can not fairly be regarded merely as incidental disturbing factors in a theoretical state of equilibrium. They are not, as Adam Smith thought, particular accidents, but organic elements in the social process. According to this view, the static assumption is unreal and violently impractical, even as a tool of analysis. It is as though we should assume that one arm grows while the rest of the body remains unchanged, and should set up on this supposition a system of physiology.

Even on the basis of traditional static assumptions it is possible to account for the existence of profits on the basis of technical innovation. A new element in technique adopted by a business enterprise may serve either to reduce the costs of producing a given product, or give rise to new products which may change the habits of consumers, or it may do both. In either case, a differential advantage accrues to the enterprise at first, as compared with its competitors. This advantage gradually disappears, the rate of its disappearance depending upon the speed with which the new element can be adopted by competitors. Patents and other forms of monopoly tend to delay this process. The high cost of the necessary fixed plant may do likewise. But in spite of such factors as these, there is a strong (*Continued on page 256*)

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INVENTION AND ECONOMICS

(Continued from page 254)

tendency for innovations to diffuse themselves rapidly throughout the industrial world, where they become absorbed into the understood, accepted body of technique, and so the competitive equilibrium is restored, unless a fresh improvement appears.

The more skeptical view regards this sort of interruption in the static equilibrium as the normal state of things. The ceaseless round of improvement is conceived as an indispensable part of the industrial world, and the differential advantage which innovation brings to individual businesses is a changing quantity, compounded of individual initiative in promoting innovation, alertness in adopting improved practice available from outside sources as part of the diffusion process, and lastly, the loss by diffusion of original improvements among competitors. Further complexities arise through the fact that loss of an initial advantage through diffusion may be compensated by lower costs in related industries, so that a part of the loss is made up through external economies. To realize how these tendencies operate it is only necessary to pass in review current developments such as talking pictures, petroleum hydrogenation or the progressive cheapening of rubber tires. Against the restrictive influence of patents on the one hand is seen the ever present tendency to diffusion through exchange of trade information, voluntary or involuntary, and through elements of improved engineering practice which can scarcely be prevented from spreading.

This line of thought leads, finally, to a somewhat different view of the traditional rôle of capital in production. The emphasis on material capital goods and fixed plant tends to gloss over the vital elements of knowledge and technique, which, as we have seen, are in a constant state of growth. For example, the enormous investment in fixed plant necessary to produce heavy steel products economically is so striking that it tends to conceal the "vitaminic" elements of metallurgical knowledge which lie at the heart of the whole enterprise. This impressive collection of apparatus is, after all, only the transient embodiment of the intangible element of technique as currently practiced. It is knowledge — physical and chemical — that controls and informs the physical plant. Any chemical engineer knows that a plant is designed around a process. The plant, it might almost be said, *is* the process, bodied and given shape in accordance with such understanding of the nature of the process as the designer has attained. As H. H. Farquhar has put it: "The capital is needed to put knowledge to work and to keep it there; capital without knowledge is likely to disappear quickly in competition with those who possess both. Knowledge without capital is a stronger asset than is capital without knowledge, for knowledge can be capitalized, while capital can not be educated." *Es ist der Geist der sich den Körper baut.*

British observers have attributed much of the success of American industry to its courageous policy of forestalling obsolescence by scrapping equipment still almost new in favor of something better. The frugal European shudders at this waste, yet the practice is only a recogni-

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Cambridge, Mass.

tion of the fact that outmoded physical equipment is little more than an empty shell from which the soul has fled. The practical financial mind has usually been prone to overestimate the importance of fixed plant, though this is less true now than formerly. A sunk cost is a hard reality from the financial standpoint. It is an investment not lightly to be abandoned. The intangible elements of changing technical knowledge appear abstract and even metaphysical to the hard-headed business man, but obsolescence now takes heavier toll with each succeeding year. It drives home the lesson which the business world is learning: that the progress of technique is the controlling factor, and may wipe out, almost in a night, huge investments which had been looked to as a source of profits for years to come. The industry with costly and elaborate equipment, specialized to produce a given product in a given way, may easily find itself, with the march of change, in the position of *Tyrannosaurus Rex*, largest of the carnivorous dinosaurs, extinct because its massive carcass and none too agile brain could not adapt themselves to changing conditions. In industrial as well as organic evolution, there are blind alleys. The years are strewn with extinct species bearing witness that ceaseless adaptation is the price of survival.

Under conditions approaching monopoly, this process may be hindered or even for a time reversed. The monopolist, threatened financially by the movement of invention, may seek to thwart and repress invention. This opens the whole complex question of patents held out of use, and of tying contracts of various kinds, designed to perpetuate and extend the legitimate monopoly of the patentee. All these expedients may be resorted to in the effort to realize on an investment which has been crystallized into a narrowly specialized plant. A kind of vested interest thus exists, in maintaining the technical *status quo ante*. Under normal competitive conditions, however, aided by the rapid diffusion of technique in the industrial world, they do not avail much nor long. The increasing part which patent cases play in the administration of the anti-trust laws testifies to the importance of innovation as an instrument of industrial monopoly. This is, in fact, one of the economic problems connected with innovation which promises much acute controversy for the near future.

The upshot of these reflections is to point out the need of systematic analysis of the economic effects of innovation. In this brief article I have no more than touched upon a few of the aspects of such a far-reaching problem. It is apparent to any casual observer of contemporary life that innovation is coming to have social and economic effects both grave and, to a large extent, unpredictable. If any degree of prediction or control is to be achieved, it will be done, not by casual observation not by gaping wonderment at the marvels disclosed, but by research on a scientific plane into the economic ramifications of the innovating function. The problem lies squarely in the field of the economist, because all applied science works under economic sanctions and limitations. But the economist will have to acquire the engineering and scientific as well as the financial point of view in order to deal effectively with this ever-growing problem. Present conditions eloquently attest to the need for such economists.

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A MEMORIAL TO ROGERS

(Continued from page 245)

great number of men going out into all parts of the world to make this a better and happier place to live; we, who are Virginians, should remember that the wonderful work was inspired and put into his heart while working here in this University. For in founding M.I.T., I believe he carried with him an endeavor to put into that new work the model of the life and the type of things found at the University of Virginia. . . . "

President Alderman, chief executive of the University of Virginia since 1904 and a contemporary and close friend of Woodrow Wilson, rose to accept the tablet for the University.

" . . . I accept with very sincere gratitude this tablet commemorating the distinguished service and high intellectual equipment of William Barton Rogers . . . perhaps the most distinguished man of pure science ever connected with the life of the University of Virginia . . . who was President, and the only one from the South, of the National Academy of Science. We are very happy, through the wisdom and generosity of the alumni of the Massachusetts Institute of Technology resident in Virginia, to see this tablet take its place under the portrait of this great scientist, whose career here, and at Technology, will be recited to you by men eminent in Dr. Rogers' own field. I extend to you, Mr. Parrish, and to all your colleagues, the deep gratitude of the University of Virginia."

Rogers' second successor in the chair of physics at Virginia was present, to bring before his audience with deft touches a living picture of the man as Virginia had known him. Dr. Hoxton, though but the second physics head since 1853 when Rogers left the University, is still a young man, for his predecessor was Francis H. Smith who taught with a fire and vigor characteristic of a Rogers for well over half a century and died at the age of 99. Technology men should be interested in a prophecy made by Professor Joseph Henry (henry: unit of inductance), famed Princeton physicist and later secretary of the Smithsonian Institution, who wrote to the University of Virginia on behalf of the youthful Rogers as follows: "Mr. William Rogers, of Virginia, is well known as an ardent and successful cultivator of science. I am personally acquainted with him, and have a very high opinion of his talents and acquirements. He is one of those who, not content with retailing the untested opinions and discoveries of European philosophers, endeavor to enlarge the boundaries of useful knowledge by experiments and observations of his own. Should Mr. Rogers' life and health be spared, I am confident that he will do much towards elevating the scientific character of our country."

One naturally hears so little at the Institute of Rogers, the Virginian, that Dr. Hoxton's exposition, largely based on original sources of data, is of particular interest: " . . . in those days the professor of Natural Philosophy had a wide perspective. He was free to roam at will in the extended fields of chemistry, geology, astronomy, and physics. Rogers left his footprints in each. Today we commemorate a tablet to him in a laboratory of chemistry; in the physical laboratory are to be found his bust, his apparatus cabinet, clock, and other personal instruments; his name is graven upon the Geological building; and a clock from his department is now installed and running in the Astronomical observatory. . . . "

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President Compton in his inaugural address, quoting from Rogers' original plan, made the following comment which the speaker appropriately included: "Dr. Rogers then goes on to outline an organization and a curriculum which are astonishingly like those of today, which have stood the test of time and experience. As an example of constructive imagination, good judgment and prophetic vision, I wonder whether there is an equal to this in educational literature."

Four persons present in the audience attending the dedication exercises had met and known Rogers. Two of them were the son and daughter of Francis H. Smith; a third was Francis Perry Dunnington, distinguished emeritus professor of chemistry. One of these tells, first-hand, of Rogers' own presentation of his scientific masterpiece, the geology of the Appalachian chain: "A grander geological theme could hardly be imagined. It related to the physical structure of a mountain chain 1,300 miles in total length, extending from Vermont to Alabama and 100 miles in greatest breadth, with strata so folded, warped, contorted, fractured and eroded that science had sought in vain to find a key to their original structure. Yet the genius of the brothers Rogers (William and Henry) had, like the Egyptologist with the papyrus roll, unfolded the inverted and contorted strata, spread and smoothed them out, as it were, in an open book, and showed them to the eye of science as originally horizontal deposits, continuous with the rocks of the great western coal fields. . . . The impression I have of this exposition, as delivered, is that it was the most lucid and elegant effort of oral statement to which I ever listened."

Dr. Hoxton testified to Rogers' brilliance and popularity as a lecturer in an account which well deserves space for the sake of its freshness and vivacity alone.

The founder and first president of Technology spoke again through the person of Dr. Stratton, who read as his contribution to the program, what was perhaps the most fitting document that could have been found for the occasion — Rogers' memorial to the Massachusetts Legislature on the plan for a technological institution. Of equal interest were his own remarks, of an introductory or commentary nature: " . . . the thing that impressed me more than anything else was his prophetic vision and it can only be explained by his experience with all of the Sciences. I mean his vision as to the development of the industries of this country and the part that Sciences play in it . . . he never lost sight of technology in relation to general education . . . he predicted and prescribed what has become our great engineering societies . . . it may be of interest to know that at present it is proposed to establish a technological press for the very purpose this was intended. Our periodical will also carry articles translated from foreign languages. Just at present the Japanese Government has done a great piece of work in earthquakes. They have agreed to publish this work and translate it and turn it over to us for publication. This is a small part of the work predicted by Rogers, but a very important part for us at this time . . . the outline of this proposed museum is really that of the one at Munich. If the Institute had followed Rogers' suggestions, this country would undoubtedly have had the first of its kind. Philadelphia is planning one, also (*Concluded on page 260*)

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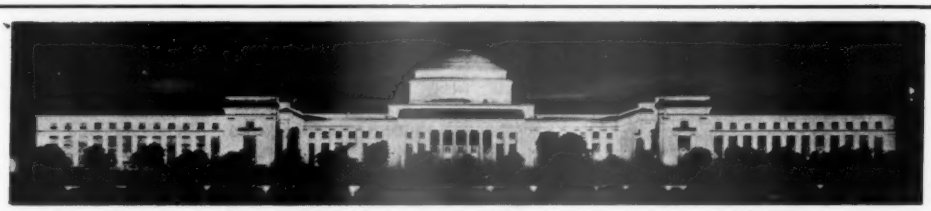
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A MEMORIAL TO ROGERS

(*Concluded from page 259*)

Chicago and New York. It will not be long before the museum will be a part of each great city or community. . . . "

Dr. Stratton emphasized the following paragraph in Rogers' treatise as the most important statement in his argument: " . . . in this division it should be the first object to impart a thorough knowledge of the fundamental principles of the several branches of physics, as mathematically and experimentally demonstrated; and then to conduct the more strictly practical instruction, as much as possible, under the guidance of these primary truths."

Of the 174 Technology men now resident in Virginia, a goodly representation attended these exercises. Familiar figures besides J. Scott Parrish '92, were Don Frazier '11, secretary of the Technology Club, and Al Higgins '01. The local committee consisted of Walter S. Rodman '09, James S. Miller '25, and Lauren B. Hitchcock '20, who functioned under the leadership of Edmund S. Campbell '06, head of the School of Art and Architecture. The four wives constituted a women's committee under the direction of Mrs. Rodman and served tea in the Colonnade Club at the conclusion of the program.

THE FASTEST TRAINS

(*Continued from page 235*)

fastest trains which hover around the "mile-a-minute" mark are:

1. London to Bath; Great Western, 105 mins. 106.9 miles
2. Paris to Jeumont; Nord, 150 mins. 146 miles (Jeumont is a stop on Belgian frontier)
3. London to Exeter; Great Western, 173 mins. 173.7 miles
4. Paris to Calais; Nord, 190 mins. 186 miles

Non-stop portions of the routes of long-distance American and Canadian limiteds as published not long ago in the *Railway Age* yield data which approximates the above times:

1. Valpariso to Ft. Wayne; Pennsylvania's *Steel City Express;* 105 mins. 104.4 miles
2. Brockville to Montreal; Canadian National's *Inter-City Limited;* 125 mins. 125.6 miles
3. Gary to Crestline; Pennsylvania's *Liberty Limited;* 269 mins. 254.4 miles
4. New York Central's *Southwestern Limited;* on three portions of its run: 128.2, 179, and 223.5 miles are covered in 133, 186, and 247 minutes, respectively

Runs of over 500 miles in Europe between metropolitan centers are rare except where one or more international boundaries are crossed. The effect of customs delays at frontiers should, therefore, not be overlooked when contrasting the following data for 18 crack European trains with that shown on pages 236 and 237 for American and Canadian services:

(Figures indicate hours, miles, and miles per hour)

1. London-Wakefield; London and North Eastern; *West Riding Pullman*[1] 3.1 — 176 — 56.8

[1] Non-stop run.

(*Concluded on page 262*)

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THE FASTEST TRAINS

(Concluded from page 260)

2. Paris-Calais; Nord; *Golden Arrow*[1] 3.2 — 186 — 58.2
3. London-Liverpool; London, Midland and Scottish; Boat trains[1] 4.0 — 192 — 48.0
4. Paris-Brussels; Nord; *North Star*[1] 3.5 — 193 — 55.2
5. London-Torquay; Great Western; *Torbay Limited*[1] 3.5 — 200 — 57.2
6. London-Plymouth; Great Western; *Cornish Riviera* 4.1 — 226 — 55.2
7. Paris-Bordeaux; Midi; *Sud Express* 7.8 — 365 — 46.8
8. London-Edinburgh; London and North Eastern; *Flying Scotsman*[2] 8.25 — 393 — 47.6
9. London-Edinburgh; London and North Eastern; *Queen of Scots* 8.3 — 393 — 47.8
10. London-Edinburgh; London, Midland and Scottish; *Royal Scot* 8.25 — 400 — 48.5
11. Antwerp-Zurich; various State railways; *Edelweis* 12.2 — 449 — 36.8
12. Paris-Marseilles; Paris-Lyon-Méditerranée; *Côte d'Azur Pullman* 10.9 — 534 — 49.0
13. Paris-Berlin; Nord; *Nord Express* 17.0 — 666 — 39.2
14. Paris-Nice; PLM; *Train Bleu* 15.9 — 674 — 42.4
15. Paris-Rome; PLM; *Rome Express* 25.3 — 898 — 35.5
16. Paris-Madrid; Midi; *Sud Express* 25.6 — 904 — 35.3
17. Paris-Bucharest; Est and various State railways; *Orient Express* 45.6 — 1,602 — 35.1
18. Paris-Constantinople; PLM and various State railways; *Simplon Orient Express* 59.3 — 1,881 — 31.7

[1] Non-stop run.
[2] Flying Scotsman is present longest non-stop run in the world. London and North Eastern has announced the inauguration early in 1931 of non-stop service between London and Aberdeen, 523 miles.

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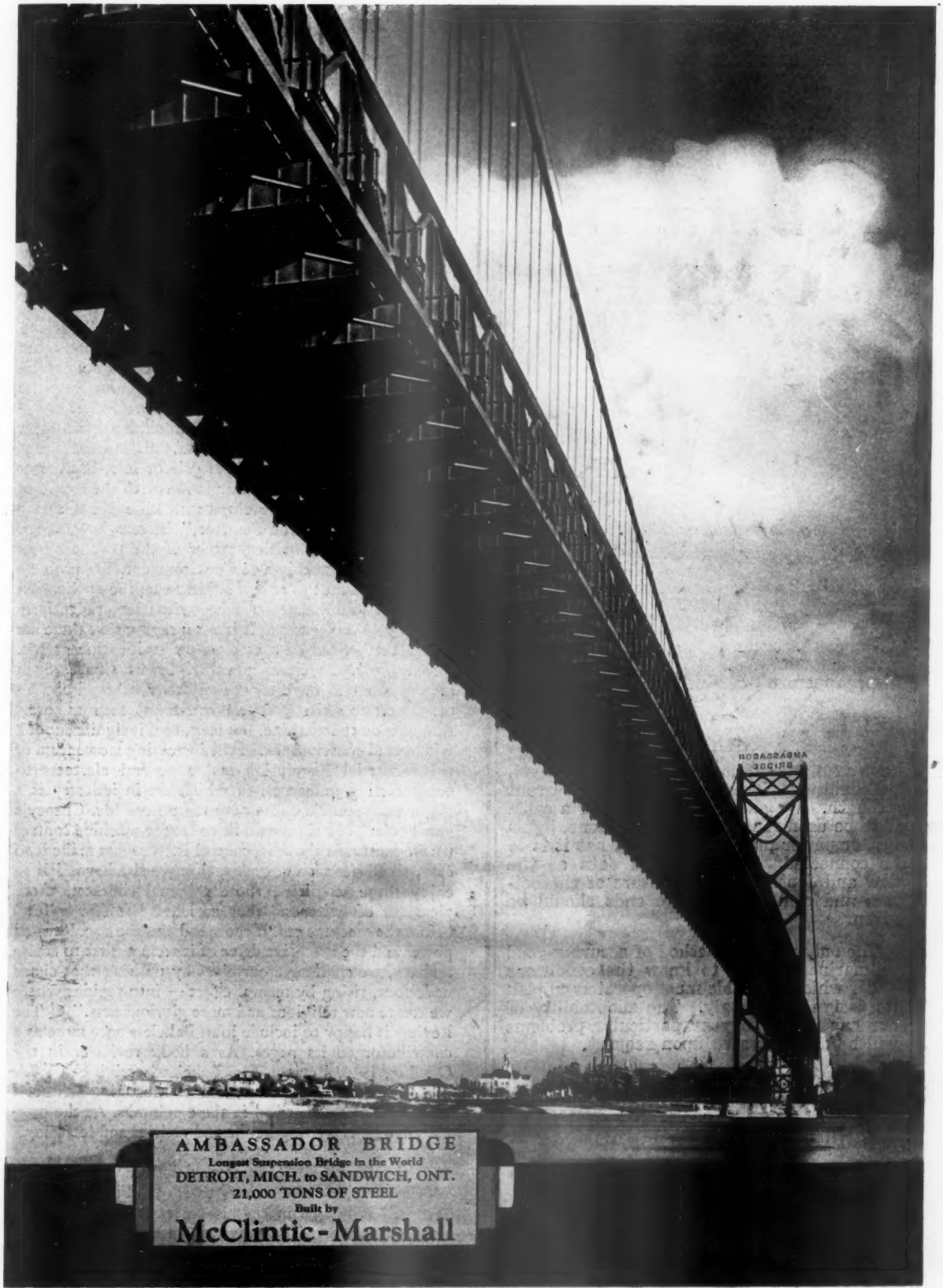

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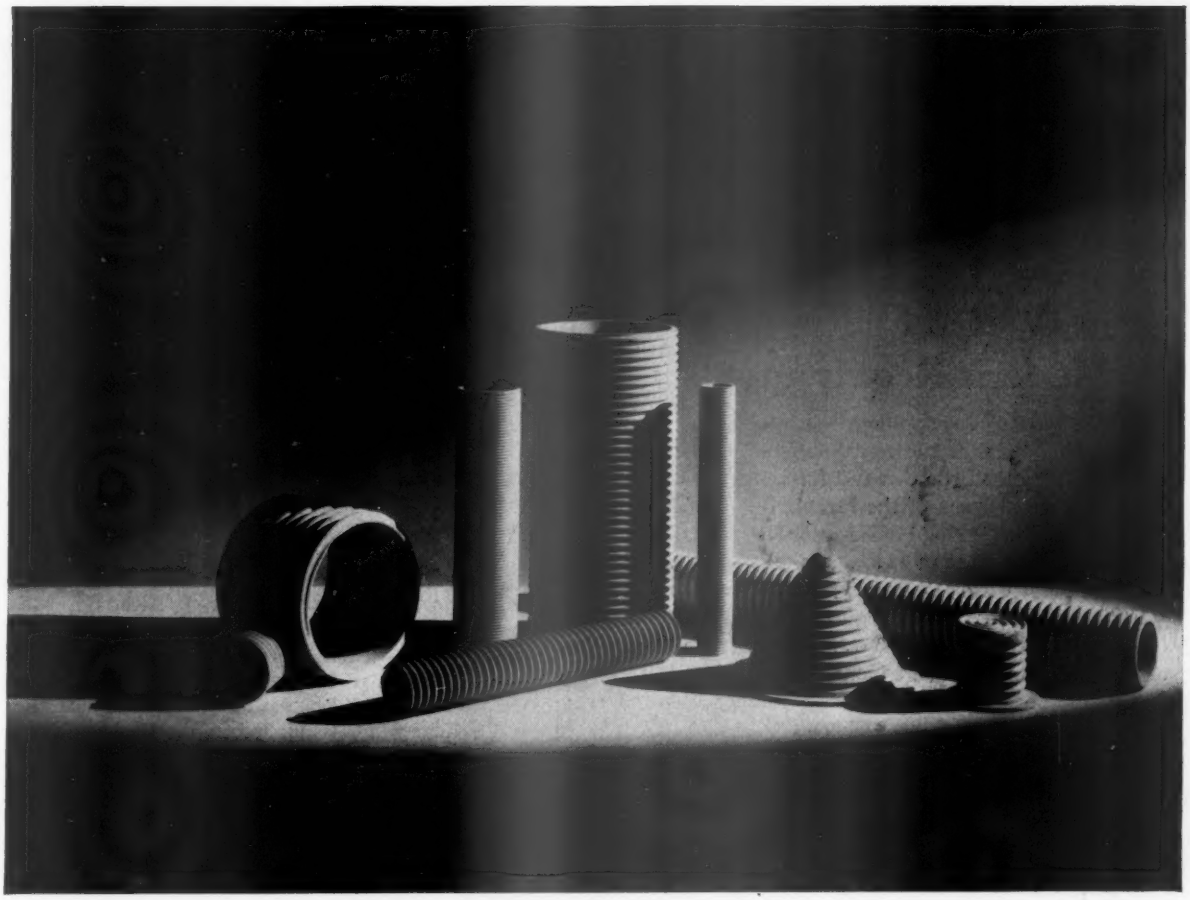
THE TABULAR VIEW

"WE ARE past," says Sheldon Cheney in his provocative book, *The New World Architecture*, "the possibility of challenging the machine, of curbing it, of attempting to escape from it. . . . We must move by machinery, communicate by it — live by it." In his article, "Machine-Made Minds," Mr. BAKELESS develops a correlative thesis: we cannot escape having our thinking conditioned by the machine. In so doing, he has brought out, as did the recent play "Berkeley Square," the impossibility of modern man to be happy in any other environment. The romance of the past could not substitute adequately for the relinquished comforts of the Twentieth Century. ¶ Mr. Bakeless, we feel, has attained an admirable state of Teufelsdröckhian detachment from the usual prejudiced criticism. His interest is not inspired by prospects of personal gain or loss, but comes rather from a very real preoccupation with the course of human progress and development. Like the German philosopher of "Sartor Resartus," he sees beyond the superficial aspects, writing rather of the psychological consequences of man in a new environment. The problem is thus interpreted as one of adjustment: the application of natural intelligence to a new situation, potentially neither good nor bad. ¶ It is encouraging that there are such astute critics of contemporary civilization as Mr. Cheney, Mr. Bakeless, and Mr. Stuart Chase. Such attacks seem to have awakened many otherwise critically inert to write (overfreely perhaps) their minutest thoughts on the machine. But that, too, is significant of a widespread consciousness of the increasing momentum of the Industrial Revolution and a general alertness to counteracting influences, of which art in industry is a major example. To quote once more from Mr. Cheney's new book: "The sin would be to let the machine control us: we must ride above it, control it. We must make it so easy, so efficient, so noiseless, that we rise beyond it to enjoy those serenities, those spiritual contacts, those pleasures of quietness, that enriched life (for a few) before the machine era. If the speed and the concentrated power and the extensive drive of it seem at first to create a chaos, we shall save ourselves by pushing that chaos underfoot, rising by mental effort — into regions where we create new religions and more glorious arts." ¶ The Review is happy to include John Bakeless once more as a contributor to its pages. As a book reviewer in the October, 1930, Review, Mr. Bakeless' activities on *The Living Age*, *The Independent*, and as Managing Editor of *The Forum* were described in these columns. At the present time he is writing books and articles and lecturing.

THE DEUTSCHES Museum, described by HARRY J. CARLSON in his article entitled "Fifty Pfennigs' Worth," is unique in that it possesses continuity and dramatic interest. These two characteristics go a long way to make it one of the most popular museums in Europe. Not many museums can boast of visitors that annually outnumber the population of the towns in

(*Continued on page 268*)



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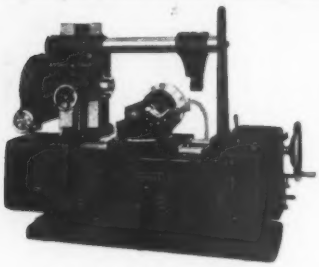

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THE TABULAR VIEW

(Continued from page 266)

which they are located. Even its manner of erection was unusual for modern times. Laborers gave their services on Sundays and holidays, and all Germany seemed to have a part in the assembling and the building. This general contribution of talents is reminiscent of the medieval spirit of community coöperation in the building of the great cathedrals. The results in both cases were more than could ever be obtained through organized labor. ¶ All this became possible under the direction of the remarkable Dr. Oscar von Miller who thus created the most outstandingly successful experiment in visual education yet made. Within this one building are the contributions of centuries of scientific development, forming nine miles of exhibits — 60,000 things to see — and each occupies its proper place in the evolution of the major branches of science, engineering, and industry. ¶ Although Mr. Carlson was born in St. Paul, Minnesota, he has lived in Boston most of his life. After his graduation from the Institute in 1892 he studied at the Atelier Duray, Paris, for two years. Since 1903 he has been connected with the firm of Coolidge and Carlson, architects. While continuing his practice of architecture, he lectured at the Massachusetts Normal Art School on the History of Architecture and Building Construction. As an alumnus, he has been unusually active in affairs of the Institute. He became a life member of the Corporation in March, 1921, and was President of the Alumni Association the following year. As an architect, his services were of value to President Maclaurin as one of the three architectural advisors in regard to the location of the new Technology buildings. He is also known as the architect of the new Guggenheim Aeronautical Laboratory at the Institute. Some of his best known structures are: "Dreamwold," the estate of Thomas Lawson; the Normal and Latin Group, Boston; Harvard, Wellesley and Technology dormitories; and the library of Hamilton College. In 1928 Bates College awarded an honorary master's degree to Mr. Carlson, "whose mastery of one of the finest of arts has given to this campus three notable buildings. He is a preacher in stone of the gospel that utility is most useful when joined to beauty."

DONALD C. STOCKBARGER, author of one of The Review's most celebrated articles, "Check the Sun Bath," appears again in this issue. His article, "The Useful Spectroscope," surveys the contributions that spectroscopy has made to the sciences. "The spectroscope," reads the article, "has become one of the greatest of the tools of science, yielding secrets about chemical compounds otherwise undiscoverable, reaching out to the stars, breaking into the atom, showing the kinship of the infinitely large with the unbelievably small." ¶ Dr. Stockbarger has labored long in the field of radiation. The radiation laboratory at the Institute, which is under his supervision, was among the first of its kind to be established in this country. Work has been carried on

(Continued on page 270)

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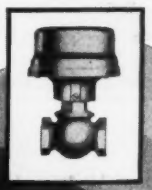

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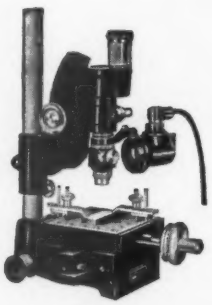

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THE TABULAR VIEW

(Concluded from page 268)

there in great variety, ranging from such mundane things as detecting fraudulent checks to studying rays that cure rickets; from investigating the properties of ultraviolet transmitting glass to enlarging the frontiers of pure science. Dr. Stockbarger was graduated from the Institute in 1919, joined the instructing staff in 1920, and received his doctor's degree in 1926.

WITH this issue DANIEL C. SAYRE makes his introductory bow as a contributing editor to The Review, joining Professor Tenney L. Davis, '13, and Mr. W. P. Cutter. Professor Sayre will contribute articles on aviation. As an Assistant Editor of *Aviation* and as an Associate Professor of Aeronautics at the Institute, his *bona fides* as a writer on aviation is not to be questioned. Professor Sayre is a member of the Class of 1923 and holds his master's degree from the Institute. He was one of the founders and promoters of the Boston Airport Corporation and he has been active in other ways in the field of air transportation. An article of his on that topic appeared in The Review for May, 1929.

THE water color on the cover of this month's Review was executed in 1929 by Mr. ROBERT C. DEAN on a trip to Europe as a traveling fellow of the Institute. It was made at the Krupp Factory in Essen, Germany. Mr. Dean was graduated from Technology in 1926 and obtained his master's degree the following year. He is now connected with Perry, Shaw and Hepburn, architects, and is also an instructor in the Institute's Department of Architecture. ¶ On page 274 are reproduced examples of a series of 12 murals recently executed by Henry Billings, artist, and exhibited in New York. Designed in the modern spirit, they are intended for modern buildings.

REGAULT, a contemporary of Pasteur and a professor at the Collège de France, won fame in his short life by the elegance and apparent ease with which he presented his scientific lectures. Once when congratulated upon this expository power, he remarked, "Ah, you do not see the steel corsets that I wear when I am speaking." Behind his facility lurked perpetual restraint, the mark of a true scientist. ¶ The incident is recalled by the continual constraint that must be exercised in conducting an interpretative scientific magazine. If such a journal is to be worth its salt, the editorial office must wear a steel corset even though the results of its work be sometimes marked by elegance and facility. It is necessary that every scrap of information be rigorously appraised and subjected to the scrutiny of experts, that mere publicity and propaganda be excluded, that the flood of scientific sewerage be not taken for the distilled water of science. Visitors to The Review office frequently remark about the Gargantuan waste paper basket that reposes beside the Editor's desk. They are told that it is the limbo of the pseudo, a symbol of perpetual restraint.